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# IX.

## *The Tornado of August 22d,* 1851, *in Waltham, West Cambridge, and Medford, Middlesex County, Mass.* (*With a Map.*)

By HENRY L. EUSTIS, A. M.

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(*Communicated February* 3*d*, 1852.)

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Meteorology is every day gaining a stronger foothold, and taking a higher rank among the sciences of modern times. It would be no great tax upon our powers of retrospection, to look back to the period when its deductions were regarded, by most persons, as the mere speculations of scientific enthusiasts, having no tests whereby their fallacy or accuracy could be demonstrated, and therefore possessing little practical value. Nor is this to be wondered at, since it is preëminently a science whose laws can be deduced only from long-multiplied observations, affording a connected series of facts, which, however diversified by temporary or local circumstances, may still betray, amid all their variety, an obedience to certain fixed principles. How far man can go in his attempt to elevate it into an exact science, whose deductions shall be worthy of implicit confidence, is not for me to say. But thus much may be confidently asserted: that, as a means to this end, we need, not much speculation and theorizing upon a few facts, but abundant observations, whereby theories may be tested, and their true value assigned to them, in proportion as they accord with the facts observed, and may serve to explain and account for them.

Among the subjects which come within the proper domain of Meteorology, the laws of storms hold no insignificant place. Accordingly, we have already a multitude of theories upon the subject, each warmly supported and defended by its advocates, but of which it is enough to say, that there is such a decided conflict between them, that they cannot all be true. It is not a question of more or less, — of generalities and details, — but of black and white. If some of these theories be established as true, the others are necessarily false; and in a matter which may be made of so much practical importance, we cannot too soon ascertain on which side the preponderance of truth is to be found.

Every science is elaborated by a slow and gradual progress from its simplest elements. A stone falls, as stones have always fallen, and from reasoning which happens to be, by one mind, directed to this every-day incident, is elaborated, only after patient study and research, our present law of gravitation. So, in all sciences, the most common events, which are presenting themselves every day before our eyes, but without exciting our attention, do finally, when reason is properly directed to them, furnish the material — rude, rough, unshapen, it may be at first — which shall, when properly elaborated, form the solid and enduring structure of the true science. In Meteorology the work is hardly begun. Storms, of more or less violence, are constantly occurring, but they come without warning, and leave behind them evidences, not only of their own desolating power, but of man's ignorance, which prevented him from anticipating and guarding against them. How many millions of dollars, and how many valuable lives, would be annually saved, if we had that precise knowledge which could tell us with the voice of recognized authority that the storm is approaching, and that the ship which we are so joyfully cheering on her way is doomed to destruction if she leave the port! Nay, more, we may deny even the possibility of prediction, and assume merely a knowledge of the mode and sphere of action of storms, and even this shall enable the mariner to direct his course with judgment, and escape their fury, instead of running, under false theories, into the very vortex of ruin. If the storm be not a solitary exception to those general laws which govern our physical world, — laws whose beauty, harmony, universality, and mutual dependence, science is every day more and more demonstrating, — then it is not unreasonable to suppose that the time will come when its laws shall be so far made known, that the wayfarer on the mighty deep shall be able to escape from the approaching hurricane, with the same certainty and decision with which we now move out of the track of the rushing locomotive engine.

To those who have lived where the hurricane or the tornado is an event of common occurrence, it would be impossible to convey any idea of the intense excitement caused in this community by the tornado of August 22, 1851. It swept through the towns of Waltham, West Cambridge, and Medford, prostrating in its path orchards, fences, forest-trees, and buildings, and involving in a few instances the loss of human life. While multitudes visited the scene of its ravages from mere motives of curiosity, and stood appalled before the exhibition of such wondrous power, scientific men sought to explore its mode of action, and to find there a corroboration or a refutation of their preconceived views. It was in obedience to the call of many of this latter class, that I undertook the survey whose results are embodied in the accompanying map.

It is not my object, in this memoir, to present any new theory upon the subject, nor even to indulge in any speculations of my own, but simply to record the facts observed, and to state in the plainest manner possible how the survey was made, in order that those who study the map may know just how much confidence is to be placed in its indications. This appears to me the more necessary, for the reason that, heretofore, the tracks of tornadoes have not generally been surveyed. The most that is ordinarily attempted is a rapid and rough reconnaissance of the ground, which, from its very nature, can embrace only the most prominent general characteristics, and is moreover extremely liable to be warped and biassed by the opinions and theories of the observer. It was sufficiently evident to me, in the course of the present survey, that had I gone upon the ground to make a simple reconnaissance of this kind, selecting spots here and there upon which to devote my principal attention, I could have found ample corroboration of almost any of the many previously existing theories, as well as of the new ones to which this particular tornado has given birth. The effect of local causes is so great, that any examination, to be worthy of credit as a test, must embrace, not isolated spots selected here and there, but a continuous track, in which all the varied circumstances of woods and plains, hills and valleys, villages and cultivated fields, may appear in their proper succession. We may even go farther than this, and assert that the law of a storm's action may often be deduced, not so much by examining what has really suffered and been prostrated in its course, as by turning our attention rather to those parts, which, lying as it were in the very jaws of destruction, have yet escaped unscathed.

It will be seen, by referring to the map, that it embraces only that portion of the track included between the foot of Wellington Hill, in Waltham, and the Mystic River. It will be a source of regret with many, that the particular portions in which they are most interested are not to be found on the map. To such I can only say, that, had sufficient time been at my disposal, I would most gladly have traced out the whole course from the beginning to the end. And this would have been the more satisfactory, inasmuch as opinion is by no means settled as to the point either of commencement or ending, — some persons asserting that its terminus was in Malden, while others, with equal confidence, maintain that it went out to sea. As a limited portion only could be examined within the time which was at my command, I have seen no reason to be dissatisfied with the selection which was actually made. A previous reconnaissance had assured me, that, although individuals had experienced severe losses in their property at points farther south in the track than that which was chosen for the starting-point of the survey, still, as a whole, the violence of the storm had been most felt in those parts which are embraced within the limits of the map. Moreover, in no other part of the track are all the varieties of surface so well displayed within the same limited extent. Emerging from a thicket of forest growth, near the foot of Wellington Hill, in Waltham, the storm crosses an open meadow, and commences the ascent of the hill. Then it passes along the crest of the hill, meeting in its way houses and barns, orchards, cornfields, fences, and forests. Now it commences its descent, and, as if gathering fresh strength at each obstacle, flies with resistless violence through the town beneath, bathes its weary wings in the waters of Spy Pond, cools its feverish breath by the demolition of an ice-house, and with renewed vigor speeds its way through the heart of West Cambridge, over the plain to the Mystic River. Here we have, within the space of a few miles, every variety of surface and every kind of obstacle presented, better than in any other portion of the route. To these considerations might be added the accidental circumstance, that this is the part not embraced in the observations of other persons. The more southerly portions of the track were reconnoitred, and the more northerly part, beyond the Mystic, in the town of Medford, is the district which was principally embraced in the report made by the Rev. Charles Brooks in behalf of the committee appointed by the citizens of West Medford. No map of either of these portions has to my knowledge been published, but in one way or another the subject has been brought before the public of this vicinity, and to such the present map will serve as a connecting link.

Before commencing the survey, I had satisfied myself by a preliminary examination of various portions of the track, that the direction of the axis line lay between N. 60° E. and N. 70° E. A compass was placed at the point of the axis line corresponding to 0, on the marginal scale of distances on the map, and a line was started N. 70° E., and staked at the distance of every hundred feet. This line was then prolonged with a graphometer, and at the same time perpendiculars to it at each stake were run out on both sides, and staked at every hundred feet. While one party was engaged in running the axis line, others prolonged the cross lines as far as any trace of the storm's action could be found, and still others were engaged in filling in the sections thus formed. The position of every tree was determined by two rectangular coördinates, and the direction in which it lay on the ground, or, if removed from its original place, the direction in which it had been carried was determined with a compass. By these means, not only was perfect uniformity preserved in the field notes, but, what was of equal importance, the axis and cross lines being first laid down upon the map, the work of plotting was very much facilitated. Having graduated two of the sides of a right-angled triangle to the proper scale, one side is placed upon a cross line at the proper distance, and the other coördinate, which is always less than a hundred feet, is read off at once, and the position of the tree marked by a needle point, without drawing a single line. Each observer plotted his own notes, on a scale of fifty feet to the inch. This large scale was adopted in order to reduce the absolute errors as much as possible, and also to facilitate the detection of any errors in the notes. The several sheets were then united, and a new map of the whole made on a reduced scale of a hundred feet to the inch.

It will be perceived, by a reference to the map, that the axis line of the survey is represented by a heavy broken line. This line is not straight, but, in order to equalize the length of the cross lines, offsets of a hundred feet or more were made in some places, where it appeared that we were getting on one side or the other of the true axis of the storm. After reaching the northern base of Wellington Hill, it will be perceived, also, that the system above described is abandoned for a short time, while crossing a part of the town of West Cambridge, and that the line is carried forward by courses running at various angles. This method was adopted in order to avoid the well-cultivated gardens of this particular district, where the encroachments of a surveying party, and the dragging of chains through flower-beds might have aroused the apprehension of the several proprietors. No inconvenience can arise from this, however, as, when once laid down upon the map in its true bearing, it is easy for any one to overlook the axis of the survey, and to mark out for himself the axis of the storm, as indicated by the traces which it has left.

A few words seem to be necessary, by way of explanation, of the frequent recurrence of the symbol adopted to represent those trees which had been thrown down, but which were replaced at the time of the survey. The storm occurred on the 22d of August. At that time I was absent from Cambridge, and even had I been present, the survey could not have been undertaken until the members of my class had reassembled, at the end of the vacation. The survey was commenced on the 2d of September, and prosecuted without interruption during a period of ten days, with a party varying from twelve to thirty. As the storm passed over a section of country which is one of the principal sources of supply for the Boston market, and therefore in a high state of cultivation, the farmers were the chief sufferers, many of them experiencing very severe losses by the destruction of their orchards. Most of these trees were simply blown down, with the roots on one side still clinging firmly to the ground, and the farmers with great alacrity set themselves at work to replace them, supporting them temporarily with shores. This work had been going on during the period of ten days which had elapsed before the survey was commenced, and as it was considered important that some trace of these trees should be preserved, though the direction of their fall could not be given, a symbol was adopted to designate them.

Some persons entertain the belief that the more fragile substances, as corn and grain, give the best indication of the direction of a storm, and this the more especially, because they attach great importance to the evidences of reaction, after the immediate violence of the storm has passed. It is not from inadvertency that no trace is left, among the results of the survey, of any observations upon this point. Several cornfields were passed on the route, and each one was made an object of special study and observation. Unfortunately, the time which had elapsed since the occurrence of the storm rendered these observations useless. A farmer with whom I conversed described his cornfield as presenting, on the morning after the storm, the appearance of a field over which a heavy roller had passed, — the stalks all bent down in one direction. But for the several succeeding days strong northerly winds prevailed, and the consequence was, that, at the time of my observations, some of the stalks were straightened up again, others bent back, and the whole scattered to every point of the compass, so that I was unwilling to record a solitary observation as reliable.

So far as the reaction is concerned, I have no hesitation in saying, that many of the exceptional cases to be found on the map are to be explained by it alone, and too much caution cannot be exercised in basing any theory upon a few cases of anomalous action. A mere glance at the map will show that, throughout the whole track, the trees generally point inwards, towards the axis, so that at almost any point a person may put his finger upon the axis line. I believe that this indication is so reliable, that I had at one time intended to mark an axis line in each of the sections of a hundred feet, by this indication alone, and then, by connecting all these, to give upon the map the true axis of the storm, that it might be shown at the same time whether it was straight or curved, and if curved, how great was its curvature. But I finally determined to leave this to be done by those who might study the map, and preferred to hold to my first resolution, to put down nothing which did not present itself on the actual survey, and thus leave every thing open to the theories of others.

But while this first conclusion is very apparent, a more minute inspection will show, that even where the general indications are most distinctly marked, in other words, where the trees do with very great uniformity dip towards the axis, — those in its immediate vicinity coinciding with it in direction, and as we remove from it on either side making a greater angle, increasing with the distance from the axis, until at the outermost verge the angle reaches nearly 90°, — at these very places we may find some trees dipping back even to an angle of 180° with the axis. Now, these are just the cases where the reaction plays a very conspicuous part. To illustrate this point, let us suppose a tree to be situated in the axis of the storm, which we will assume to be N. 70° E. As it is struck by the wind, it bends down to the ground, but its southerly roots, being strong, yield under the action without breaking. Reacting under its own elasticity, the tree flies back, and is carried S. 70° W., precisely as if the storm had originally passed over it in that direction. The northerly roots are weak, and break, the tree falls, and its direction is taken as S. 70° W. The yielding or holding of lateral roots may vary this angle more or less, and thus give us any of the exceptional cases which we have observed. This is not a mere theoretical deduction of the mode of action. In many cases, ledges of rock, strong roots, stone walls, &c., did very evidently demonstrate that the tree could not fall in the direction of its surrounding fellows, and its exception to them was amply explained by these causes. In the field notes many remarks are to be found confirming these views, but to transcribe them here, with the necessary references, would swell this memoir beyond proper limits. They are referred to merely by way of inculcating the necessity of caution in reasoning from other exceptional cases, where the fallacy of the reasoning might not be so palpably presented.

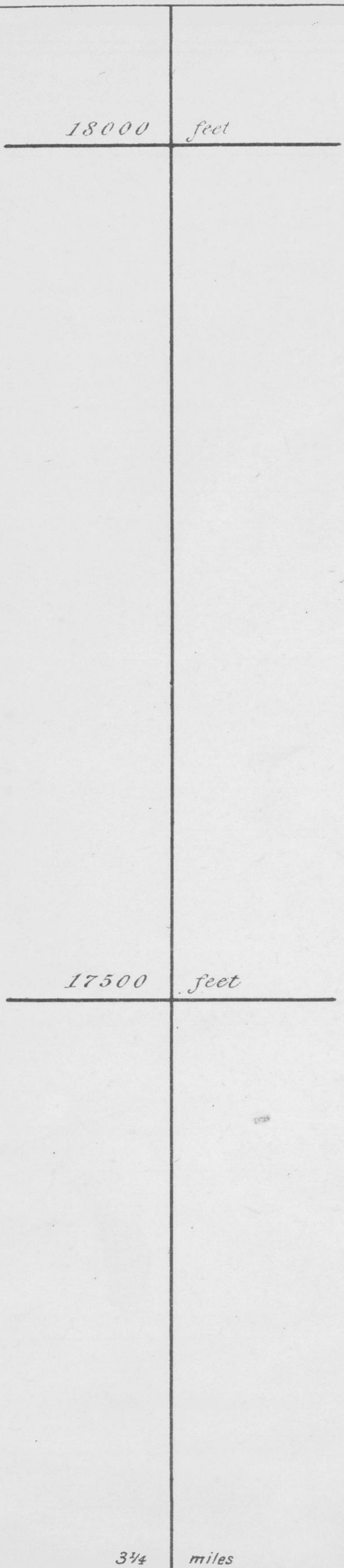
In one sense, most of the observed phenomena may be looked upon as the effects of reaction. The general indication alluded to above, of a dip towards the axis, is most satisfactorily explained, not by considering the trees as thrown down by the direct force of the wind, but rather by regarding the storm as a mass moving with great velocity along its well-defined axis, overthrowing every thing in its way, and leaving behind it a vacuum towards which every thing on the borders of its path collapsed. And confirmatory of these views are the facts observed with respect to buildings. Roofs were raised, and I was informed that a light muslin cuff was lifted from a bureau, and, as the roof fell back into its place, was caught and held suspended in the crack formed between it and the wall of the room. In one case particularly, of a factory near the West Cambridge road, the whole effect produced, and to my own mind well and clearly defined, was precisely what we should have, if we could suddenly place in a vacuum a building filled with atmospheric air of ordinary tension. Even the foundation walls were inclined outwards, and there was every evidence of a force acting from the interior to the exterior.

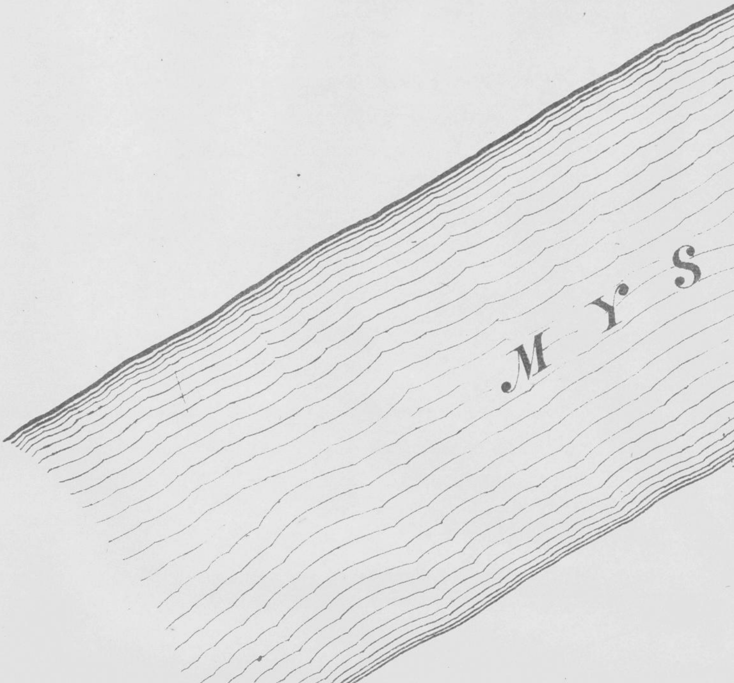
The whirl theory, both in its grand convolutions, which may require miles for its exhibition, and in its more limited sphere, in which it drags every tree from its roots, as a screw is drawn from its bed, has its several advocates. With the more extended theory I have nothing to do, leaving that to be studied out from the map. But to those who claim the more limited theory, who maintain that each tree is twisted from its bed, as one might be supposed to extract a screw, I feel bound to say, that although a most faithful search was made for evidence, yet, throughout the whole extent of these observations, only two cases have been met with, which can even be twisted to agree with their theory. A tall young hickory was found standing, and twisted 180° upon its own trunk. The top rested upon the ground. The trunk was not broken off, but the fibres were separated, and the whole appearance was precisely what you would have if you took a bundle of fibres, and, placing it vertically, held the lower half, while you twisted the upper through 180°, and brought the top to the ground. The other case is that of a chimney lying on the left or northwest side of the axis. The bottom of this chimney stood firmly, while the top was twisted round upon it, as if it had been a distinct block, the south side of it moving towards the west. Even in the case of broken trees, no evidence of twisting is to be found. Any one who breaks a green twig, by twisting one part upon the other, will find in the broken parts, especially in the bark, the evidences of torsion. But here, although many broken trees were examined, some of them broken entirely through the trunk, others only as far as the heart, no evidences of torsion were found. The fractured fibres were in every case straight.

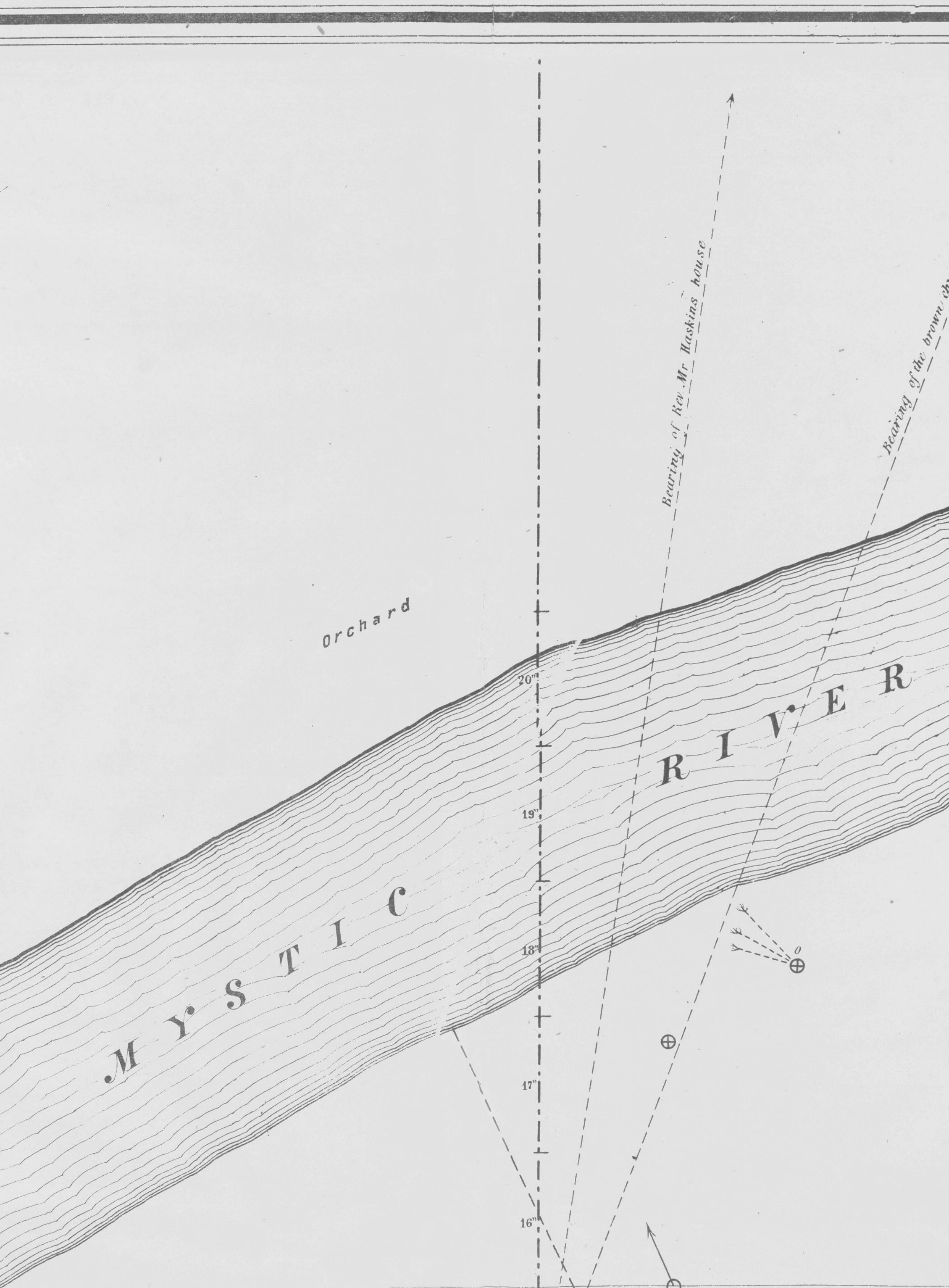
Another very significant fact, in its bearing upon this point, is the following. The course of the tornado was from southwest to northeast. It held in suspension a great quantity of muddy water, and we find, as we examine the houses, trees, and stone walls which it met with in its course, that the southwest face of these is bespattered with mud, while the northeast face remains clean. In some cases of trees which I examined, it is no exaggeration to say, that the line of demarcation between these two surfaces was as well defined, as if one face had been painted with a mud-wash and the other left in its natural state.

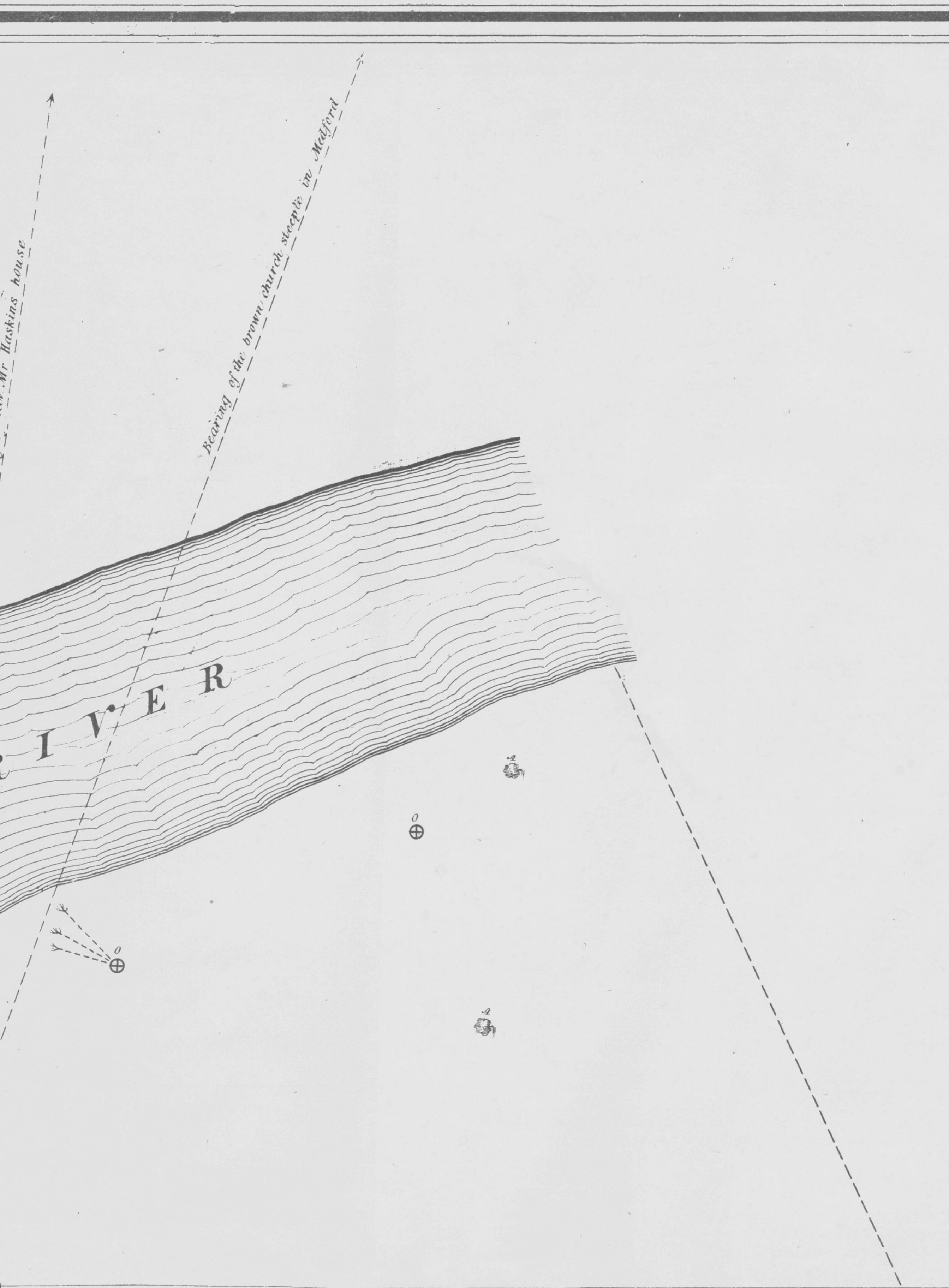
I have conversed with many persons who saw the storm-cloud, and watched its progress for many miles. There is some diversity in their accounts of its appearance, as we should naturally expect; for unless it were a perfect surface of revolution, it would appear differently as viewed from different positions, and even under the latter supposition, difference of elevation would affect its appearance. Upon one point, however, they generally agree; namely, that it had a conical shape, the vertex of the cone nearest the earth, and that it changed its distance, rising and falling as it advanced. Some add to this a lateral motion, and liken the movements of its elongated apex to those of an elephant's trunk. I mention this point merely to have an opportunity of calling attention to the facts observed during the survey, and which seem to confirm these views. In certain parts the apple-trees will be found to have suffered severely, while the tall forest-trees have escaped unhurt. In other parts we notice just the reverse, every thing of low growth having been apparently out of the reach of violence, and the only evidences of injury being found in the broken branches on the tops of the tall forest-trees. In connection with this point, I would also record one other observation. Standing upon the top of Wellington Hill, we have a fine unbroken view of the track of the tornado through West Cambridge, and a large part of Medford. Its path, wherever it had passed through woods, was very distinctly marked by its brown color, strongly contrasted with the green foliage around it. On reaching any of these places, it was found that the leaves were crisp and withered, as if scorched by a fire, or acted upon by frost, and it appeared to me that this effect was particularly marked upon the hickory-trees. The cause of this phenomenon has been variously ascribed to extreme heat, extreme cold, and electricity. My purpose is simply to record the fact. There was much speculation at the time, also, with reference to the baked apples, or, as some preferred to call them, the frost-bitten or electrified apples, which were scattered over the ground. The only observation I have to record upon these is, that they were baked, frost-bitten, or electrified only upon one side, and that, as they lay on the ground, this side was invariably turned towards the sun, which was, moreover, at that time, shining with an intensity which all my companions on the survey will well recollect.

Abundant testimony may be obtained from eyewitnesses as to the highly electric condition of the storm-cloud. One person describes a new lightning-rod upon his house as presenting the appearance of having been put into the fire. He also saw flashes of lightning from the cloud; but on this latter point, we should be cautious of judging too hastily from appearances. In a dense cloud, such as this is represented to have been, a mere board or shingle, or piece of slate, or paper, all of which were at different times held in suspension, might easily catch and reflect the sun's rays, and, by one who was looking for the evidences of electric action, such a luminous appearance would readily be mistaken for the lightning's flash. The conductor alluded to above I did not see, but in the same vicinity the following remarkable phenomena were observed. Several panes of glass were pierced with small round holes, as if a bullet had passed through them, and in one instance under the following peculiar circumstances. In a small room, with one window facing towards the south, there is a sash door opposite the window, and the sash was covered by a cotton curtain. The window is believed to have been open, and a small hole, not as large as a five-cent piece, is found in the cotton curtain, and in the pane of glass a larger one, about the size of a quarter of a dollar. The glass presents a clean fracture, and the edges are not sharp, but look as if they had been melted. We cannot suppose such a hole in a piece of glass to be much larger in diameter than the missile which produced it, and such a missile could not have first passed through the small hole in the curtain. Moreover, no further trace of it can be found, whereas a stone thrown with sufficient force to make such a hole would have made a deep indentation, and probably imbedded itself in the wall beyond. The only plausible explanation of this phenomenon seems to be found in the agency of electricity.


18000 feet
17500 feet
3¼ miles


MYS


Bearing of Rev. Mr Haskins house
Bearing of the brown ch
Orchard
MYSTIC RIVER
20"
19"
18"
17"
16"
o


Mr Haskins house
Bearing of the brown church steeple in Medford
I V E R
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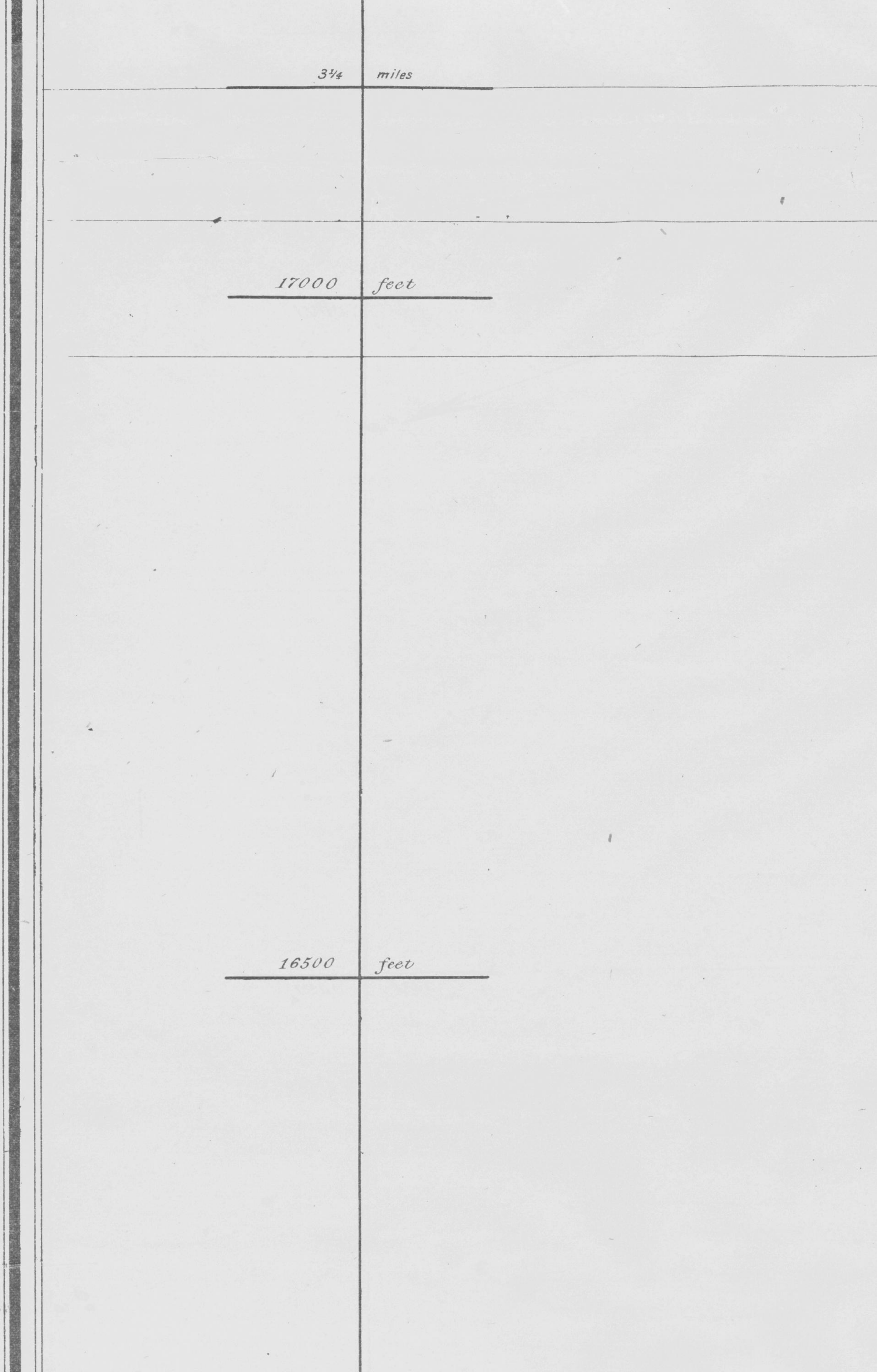
4


3¼ miles
17000 feet
16500 feet

bent
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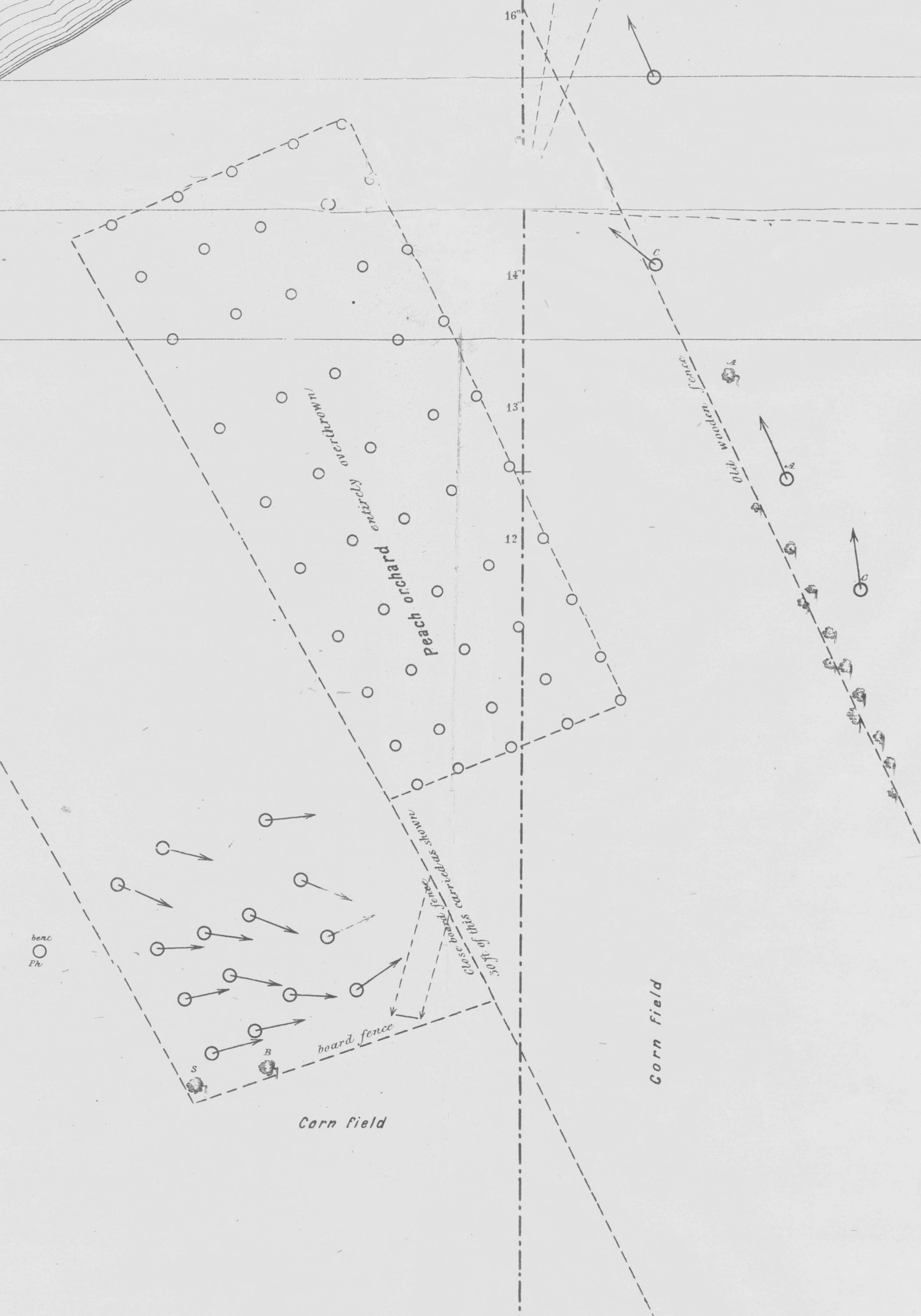
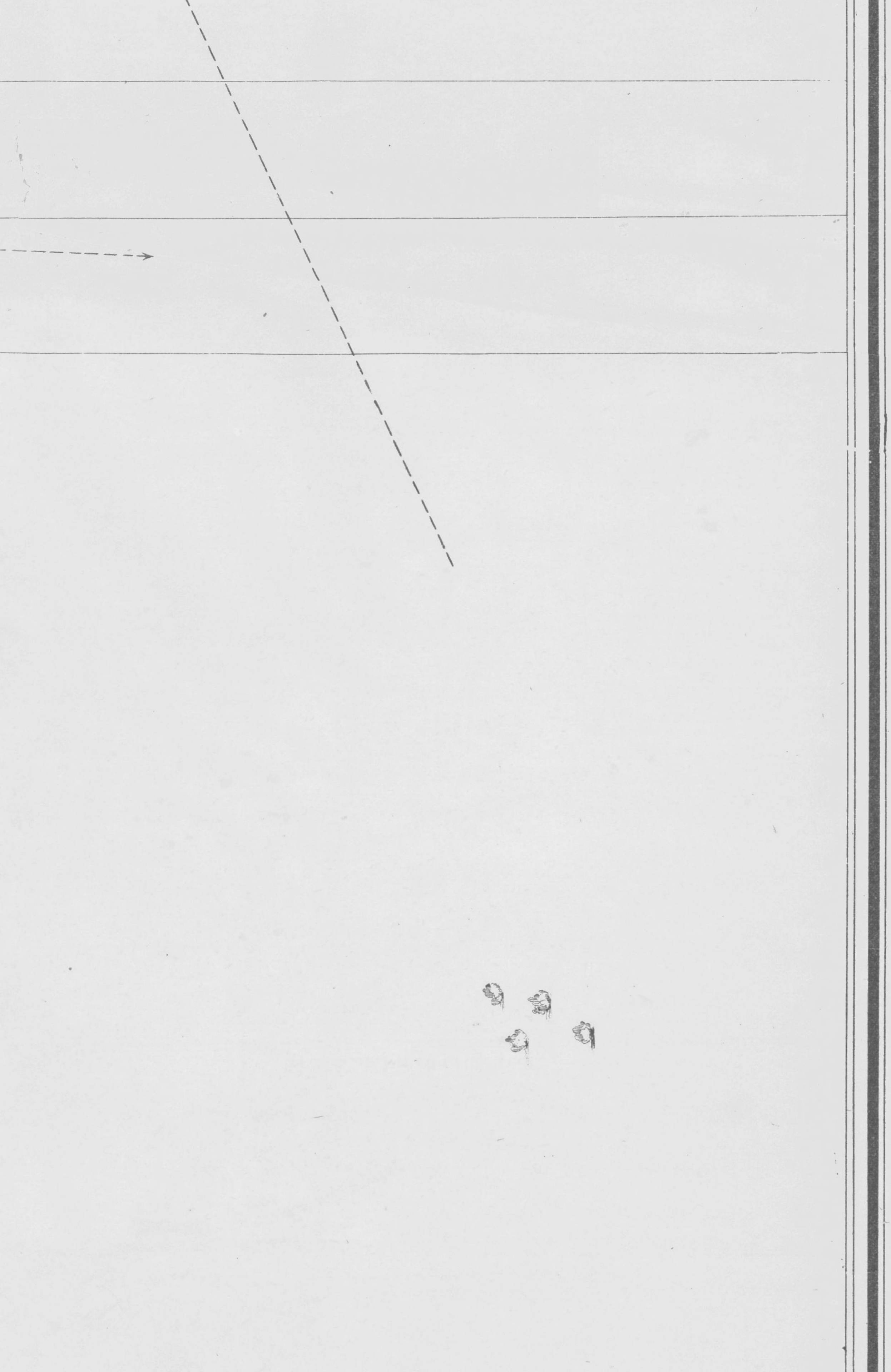
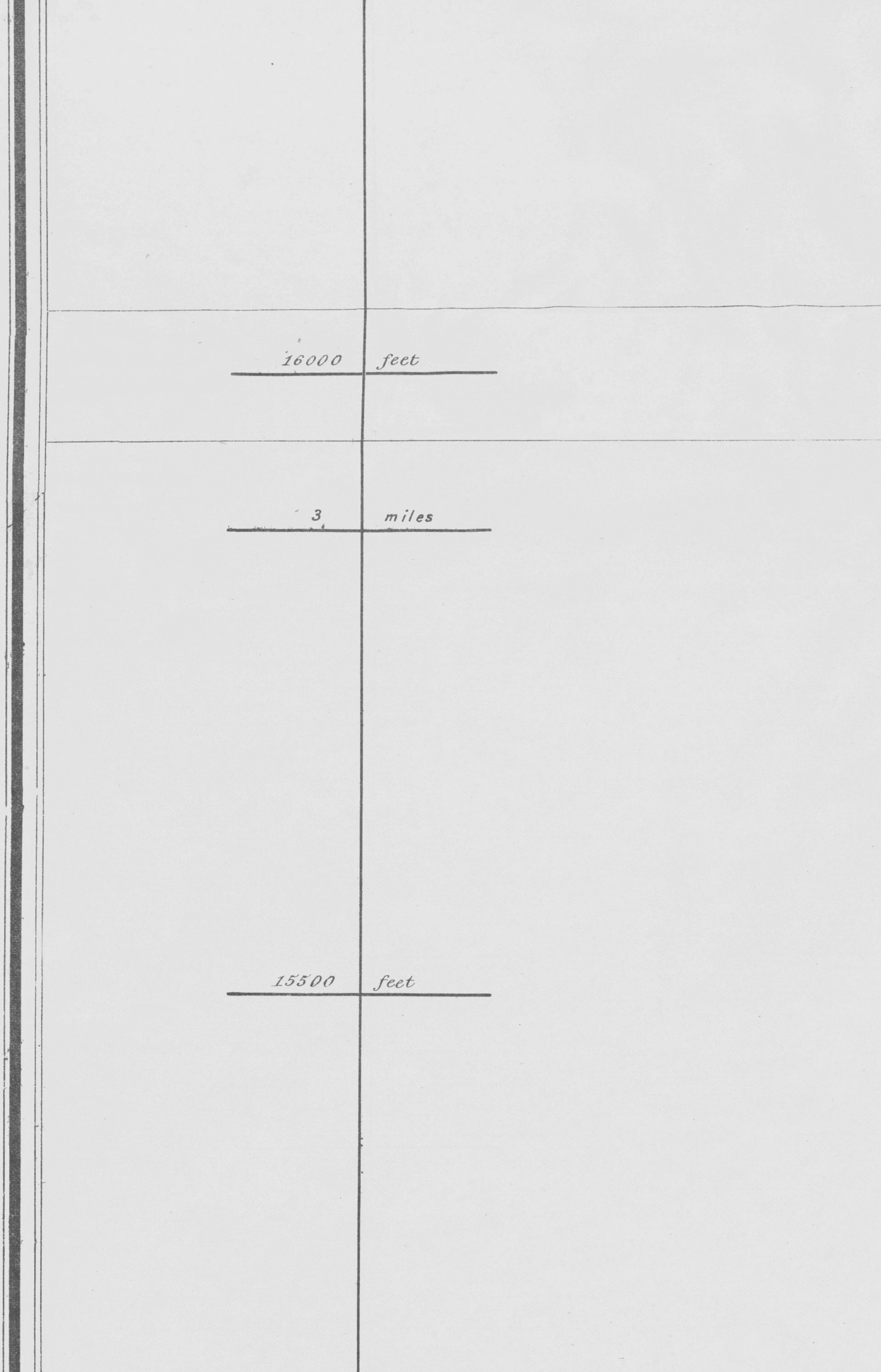
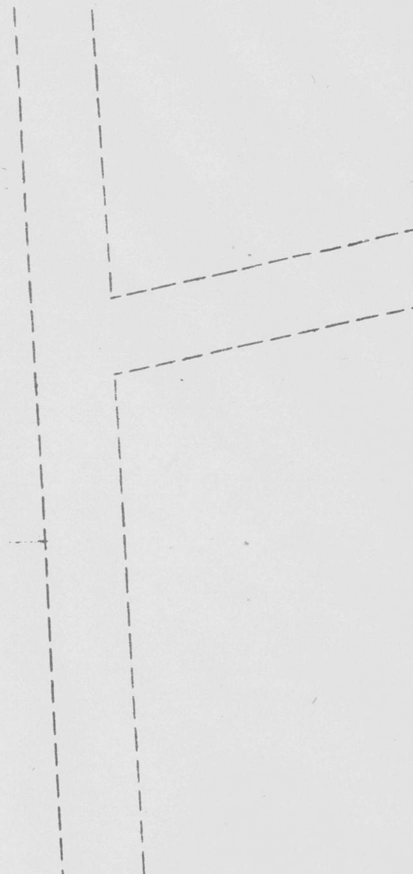
S

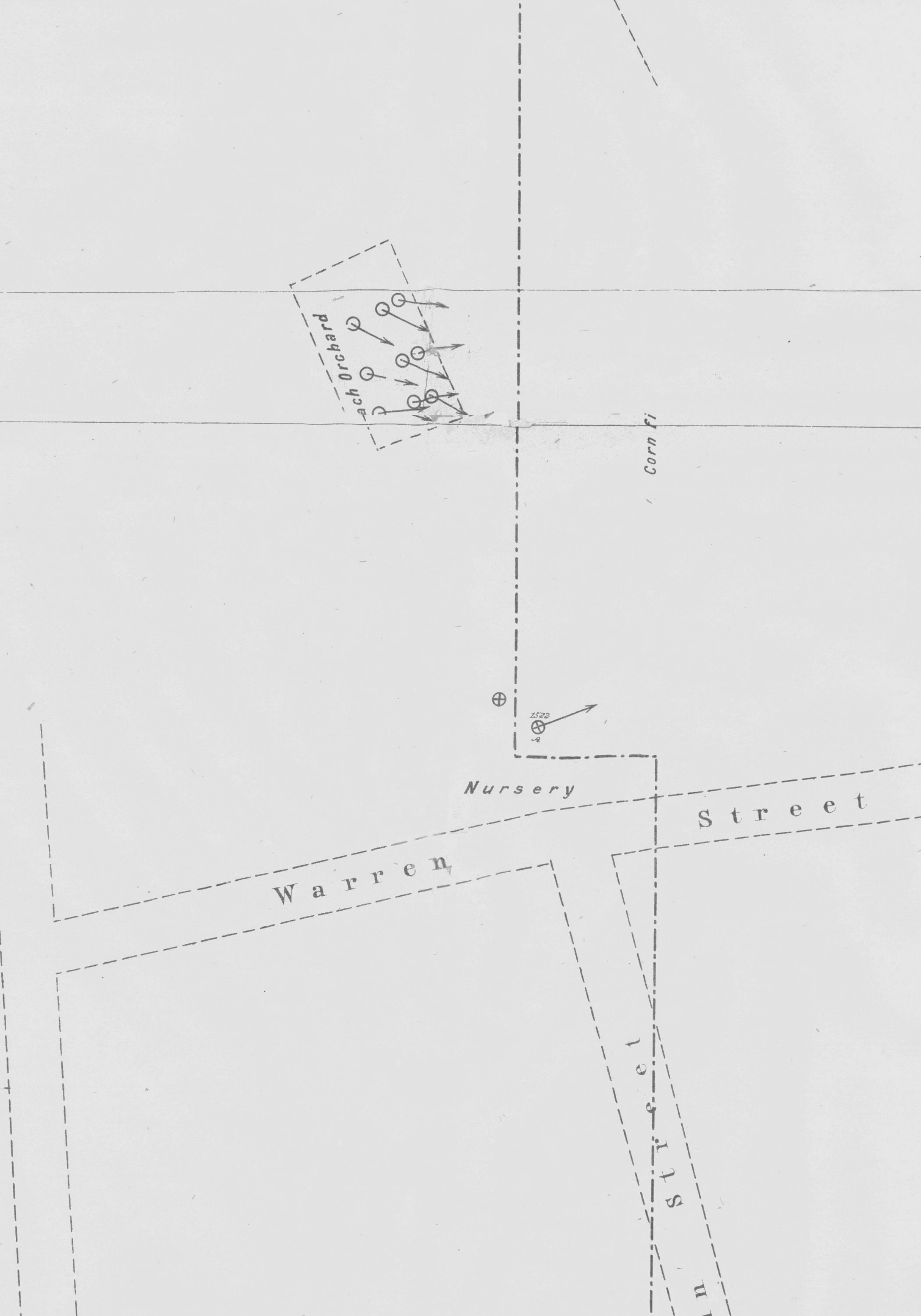

16"
14"
13"
12
C
C
A
A
C
Peach orchard entirely overthrown
old wooden fence
Close board fence
30 ft of this carried as shown
board fence
bent
Ph
S
B
Corn field
Corn field

A
Bearing of Cambridge Alms House
Old wooden fence
A
A
A
C
P

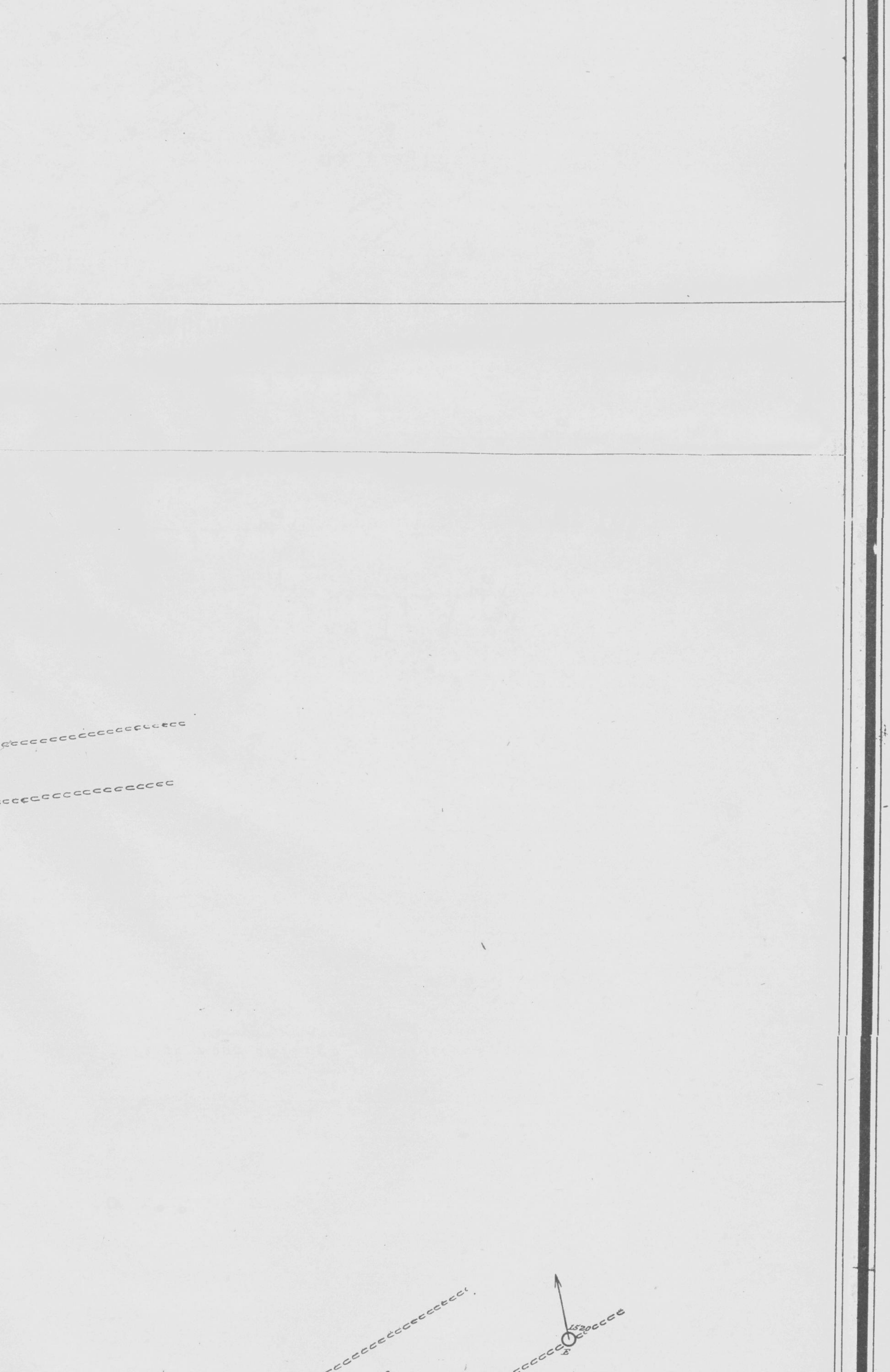


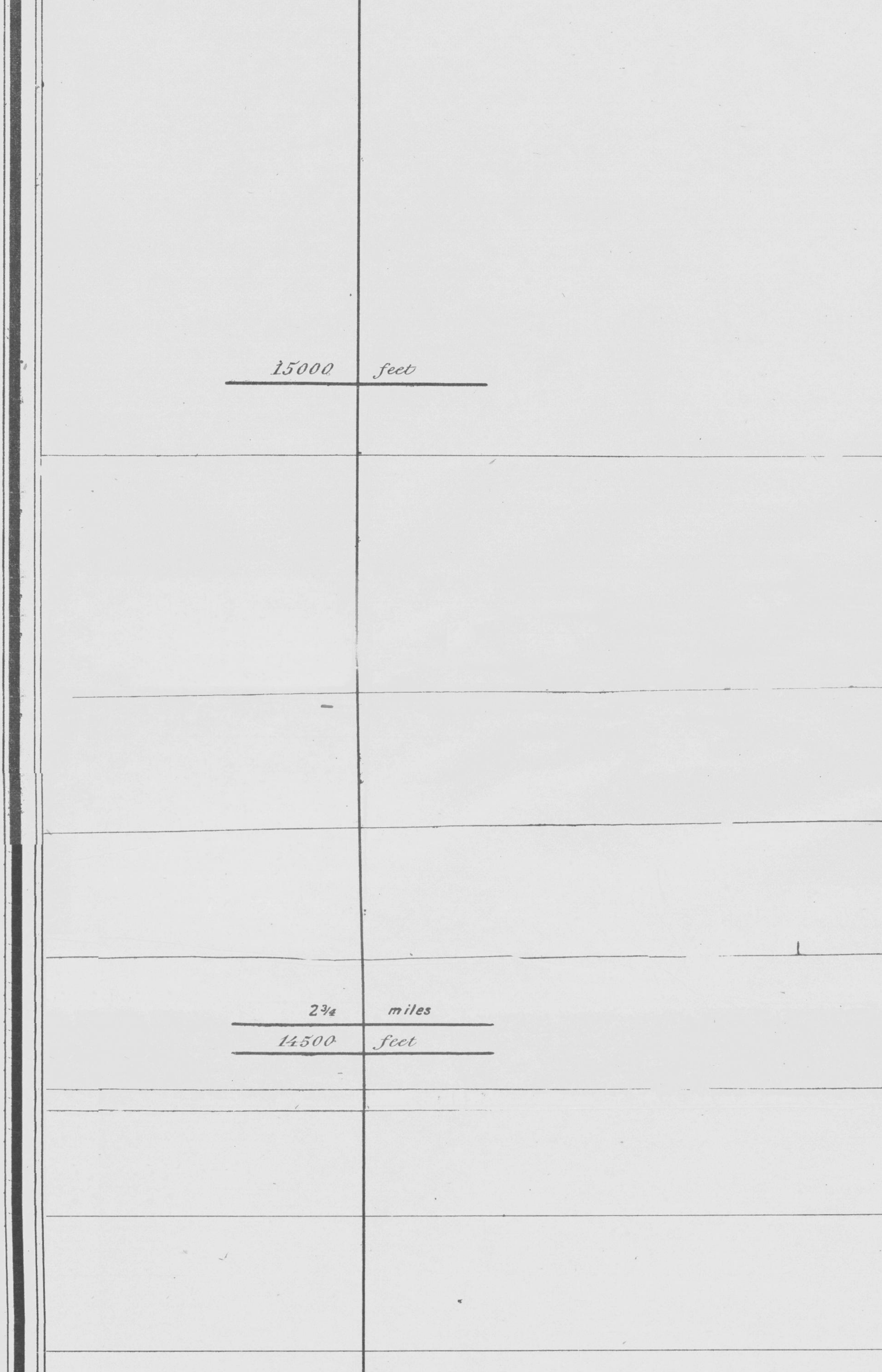

16000 feet
3 miles
15500 feet



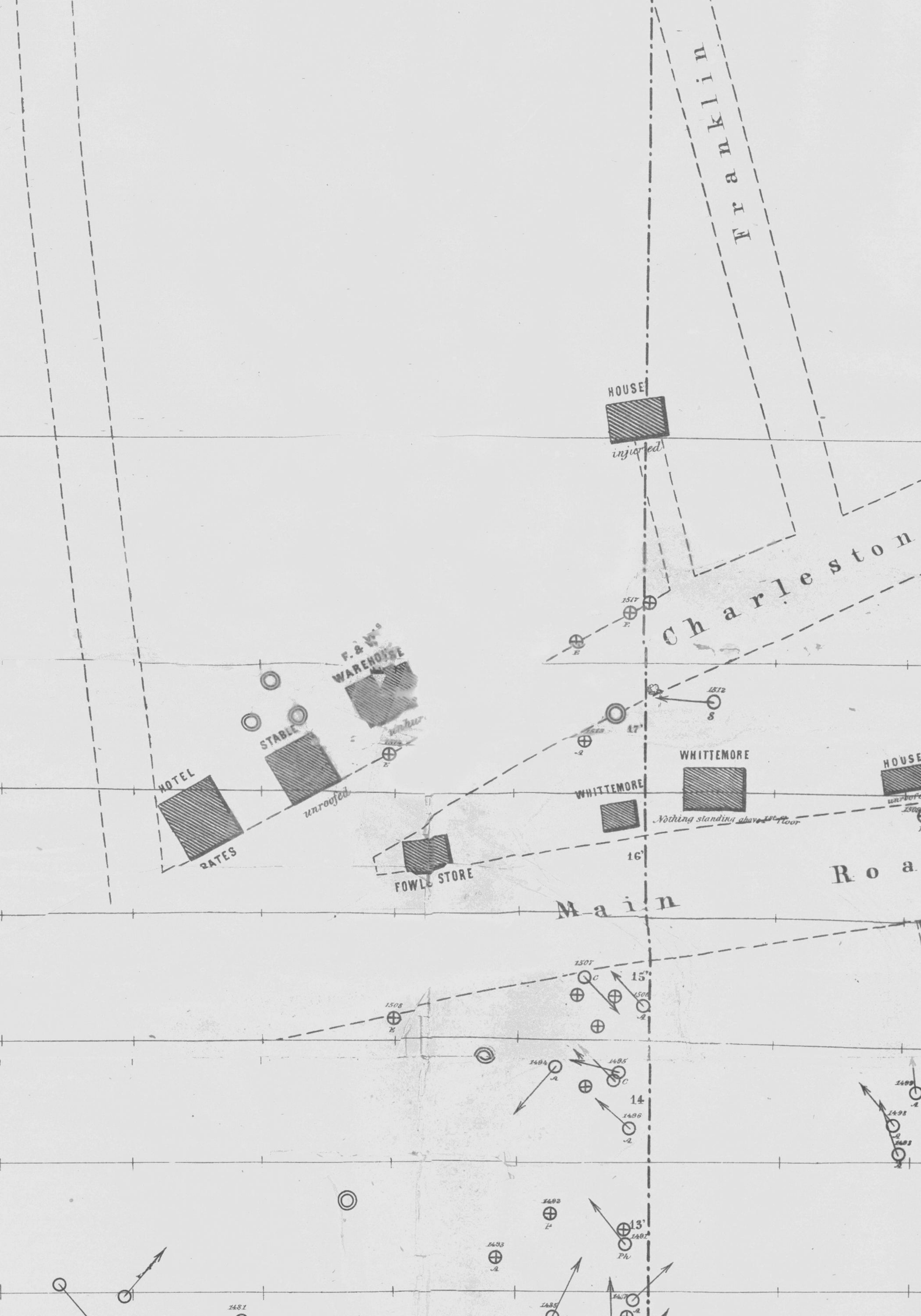

ach Orchard
Corn Fi
1522
A
Nursery
Street
Warren
Street
n

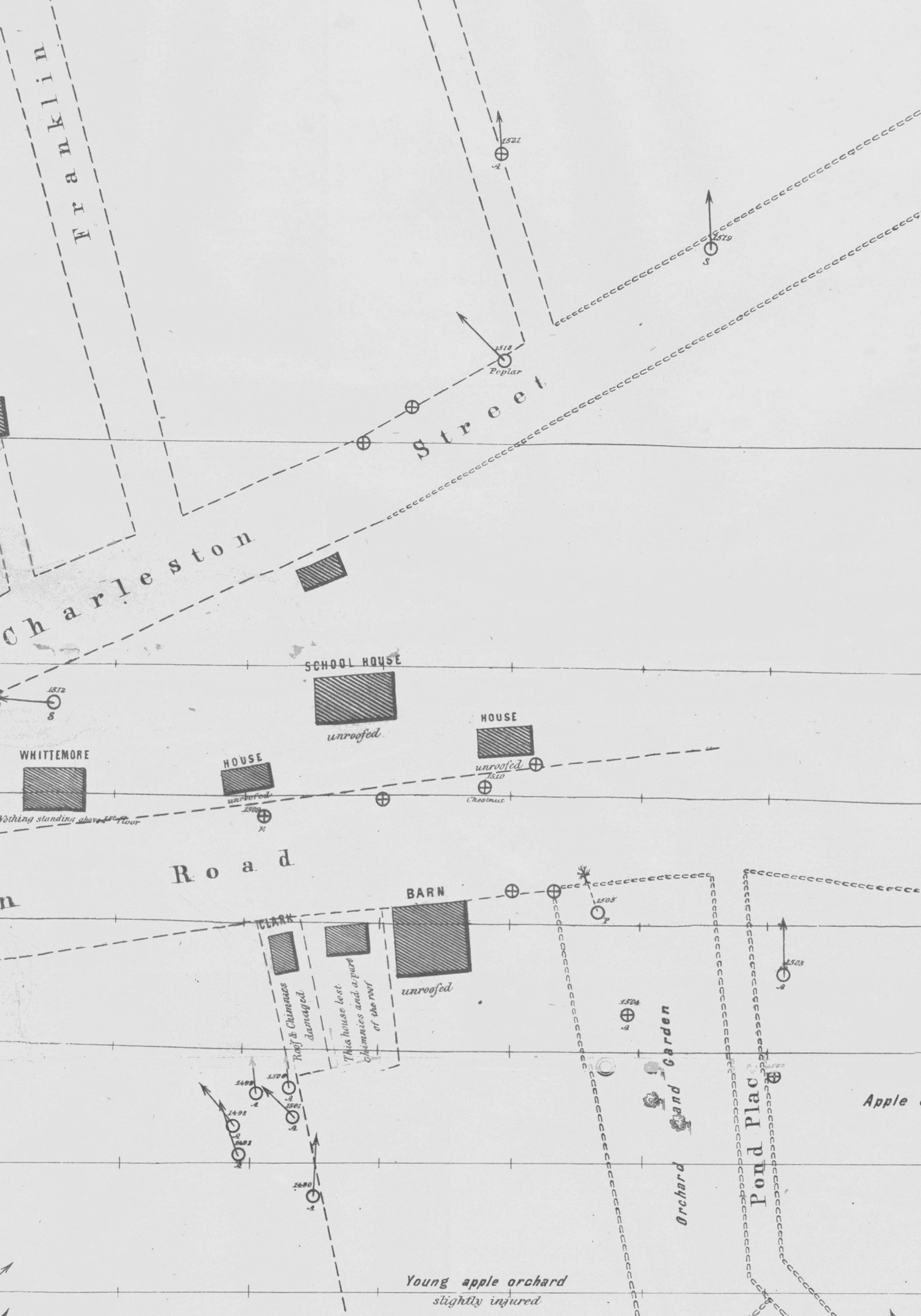
Street


1520
E

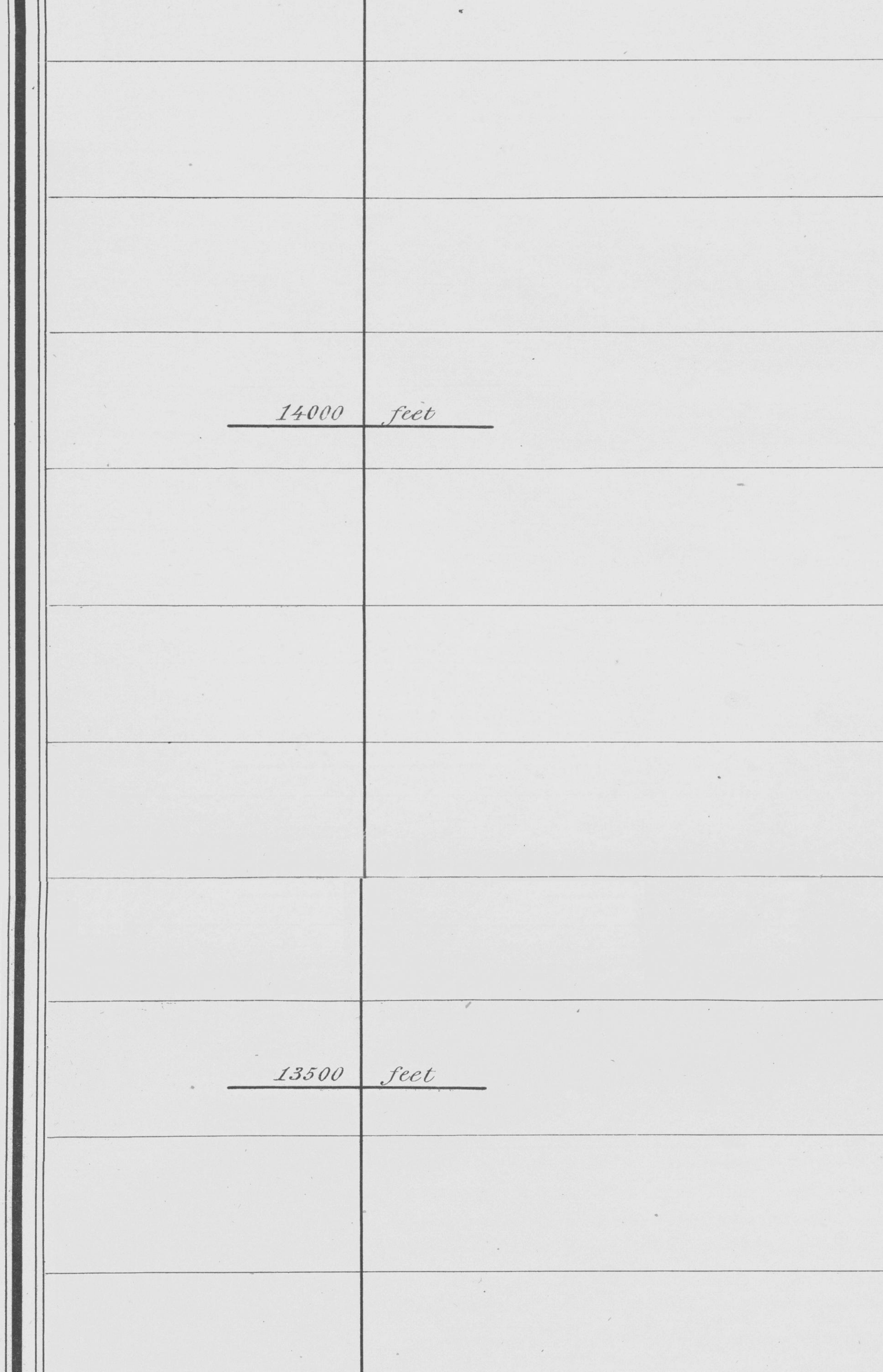

15000 feet
2¾ miles
14500 feet

HOTEL
BATES
1481

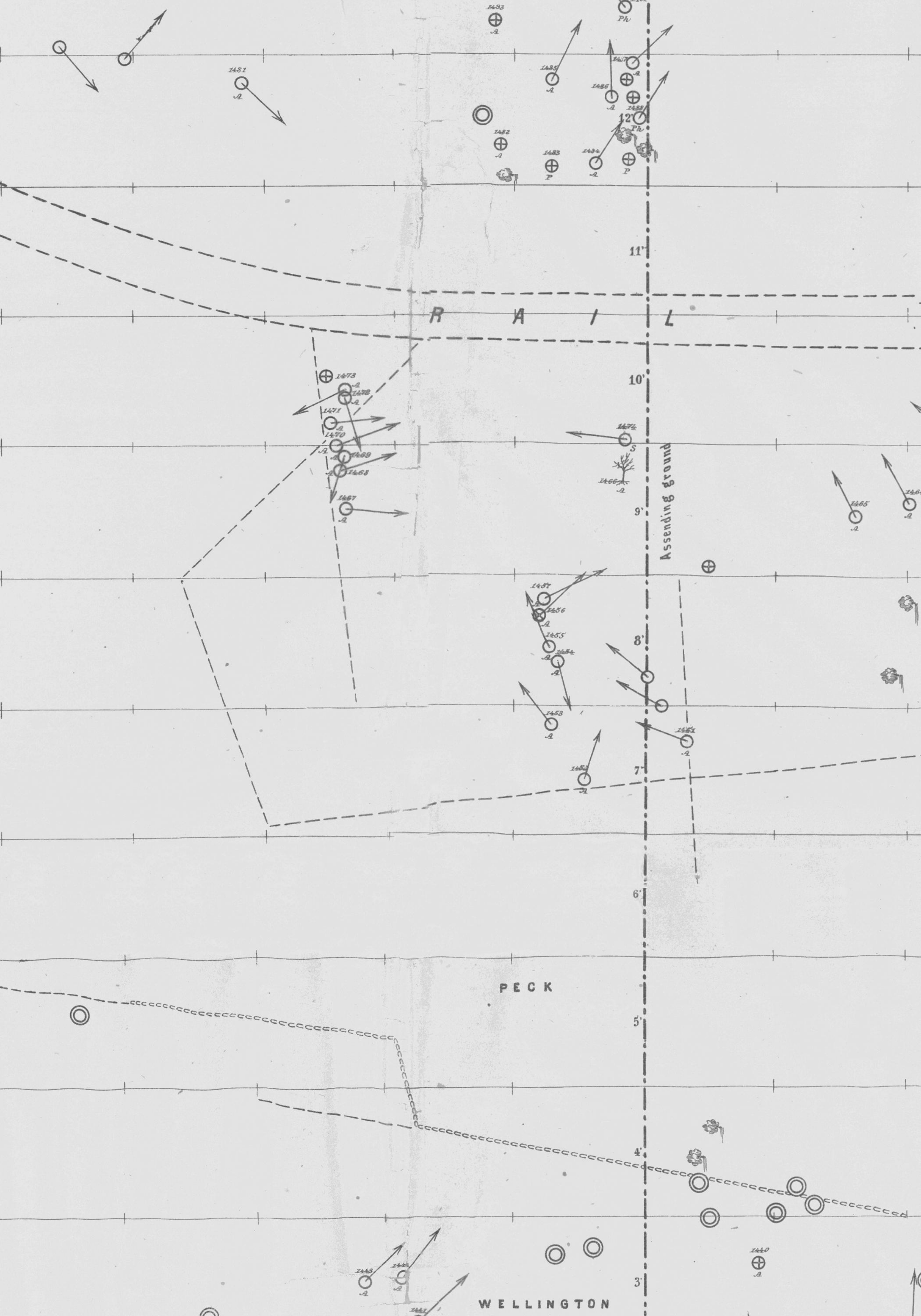

Franklin
HOUSE
injured
Charleston
F. & Wm
WAREHOUSE
unhurt
STABLE
unroofed
HOTEL
BATES
FOWLE STORE
1517
E
E
1512
S
17'
1513
A
WHITTEMORE
WHITTEMORE
Nothing standing above 1st floor
HOUSE
unroofed
16'
Road
Main
1507
C
15'
1506
A
1508
E
1494
A
1495
C
14
1496
A
1499
A
1498
A
1483
A
1492
1493
A
13'
1491
Ph
1481
1485
1487
A

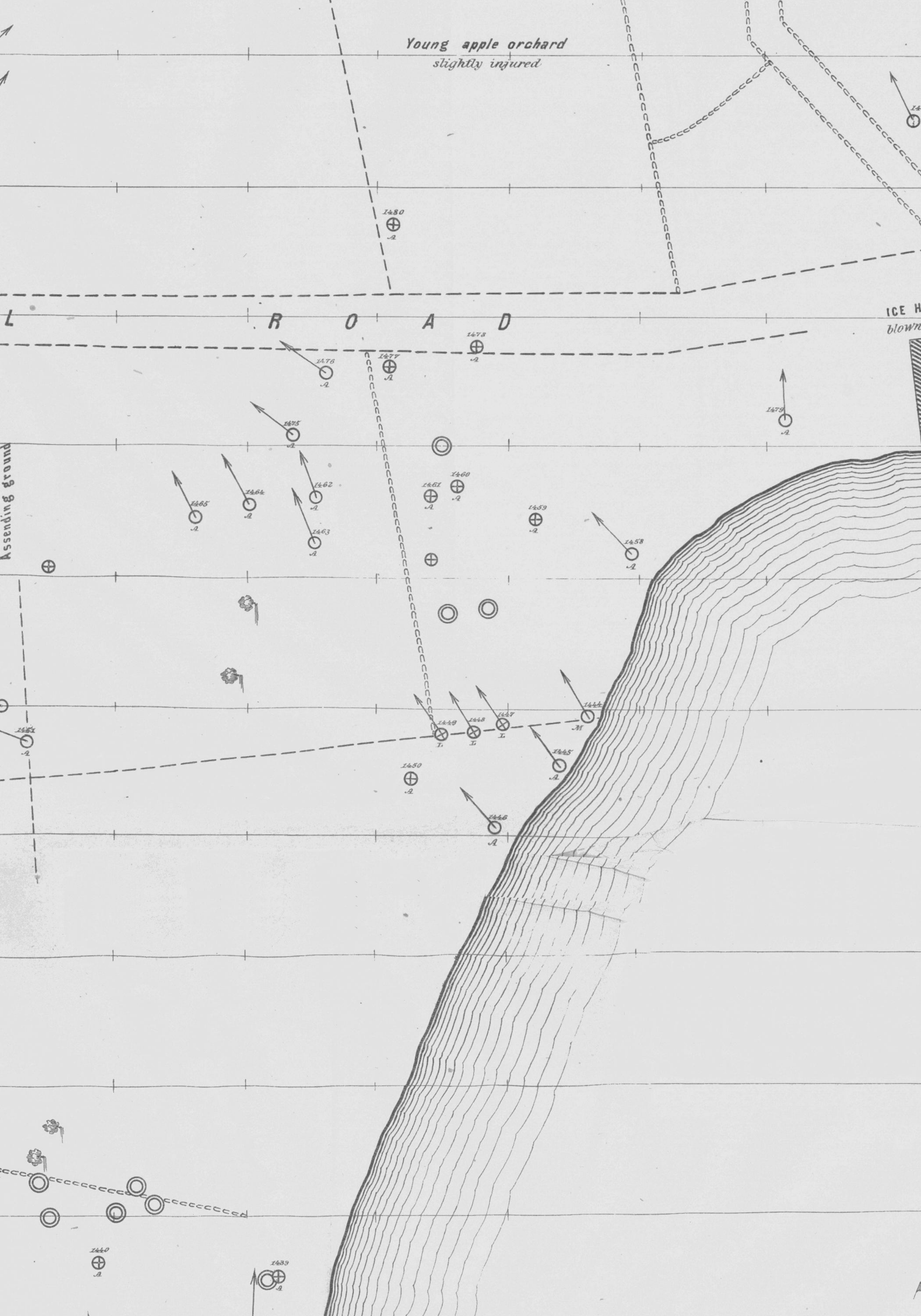

Franklin
Charleston Street
1521
A
1519
S
1518
Poplar
SCHOOL HOUSE
unroofed
1512
S
WHITTEMORE
Nothing standing above 1st floor
HOUSE
unroofed
1509
E
HOUSE
unroofed
1510
Chestnut
Road
n
CLARK
Roof & Chimnies damaged
This house lost chimnies and a part of the roof
BARN
unroofed
1505
P
1503
A
1504
A
Orchard and Garden
Pond Plac
Apple
1499
A
1500
A
1501
A
1498
A
1482
A
1480
A
Young apple orchard
slightly injured

1520
E
1519
S
1511
P
1503
A
Orchard and Garden
Pond Plac
Apple orchard


14000 feet
13500 feet

1481
A


1493
A
Ph
1481
A
1485
A
1487
A
1486
A
1488
12'
Ph
1482
A
1483
P
1484
A
P
11'
R A I L
1473
A
1472
A
1471
A
1470
A
1469
1468
A
1467
A
10'
1474
S
1466
A
Assending ground
9'
1465
A
1464
A
1457
A
1456
A
1455
A
1454
A
1453
A
8'
1451
A
1452
A
7'
6'
PECK
5'
4'
1440
A
3'
1443
A
1442
A
1441
WELLINGTON

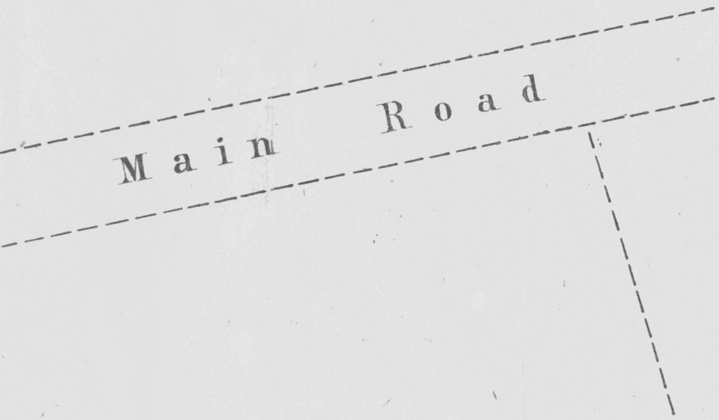

Young apple orchard
slightly injured
L R O A D
ICE H
blown
Assending ground
1480 A
1478 A
1477 A
1476 A
1475 A
1479 A
1460 A
1461 A
1462 A
1464 A
1465 A
1463 A
1459 A
1458 A
1444 M
1447 L
1448 L
1449 L
1445 A
1450 A
1446 A
1441 A
1440 A
1439 A

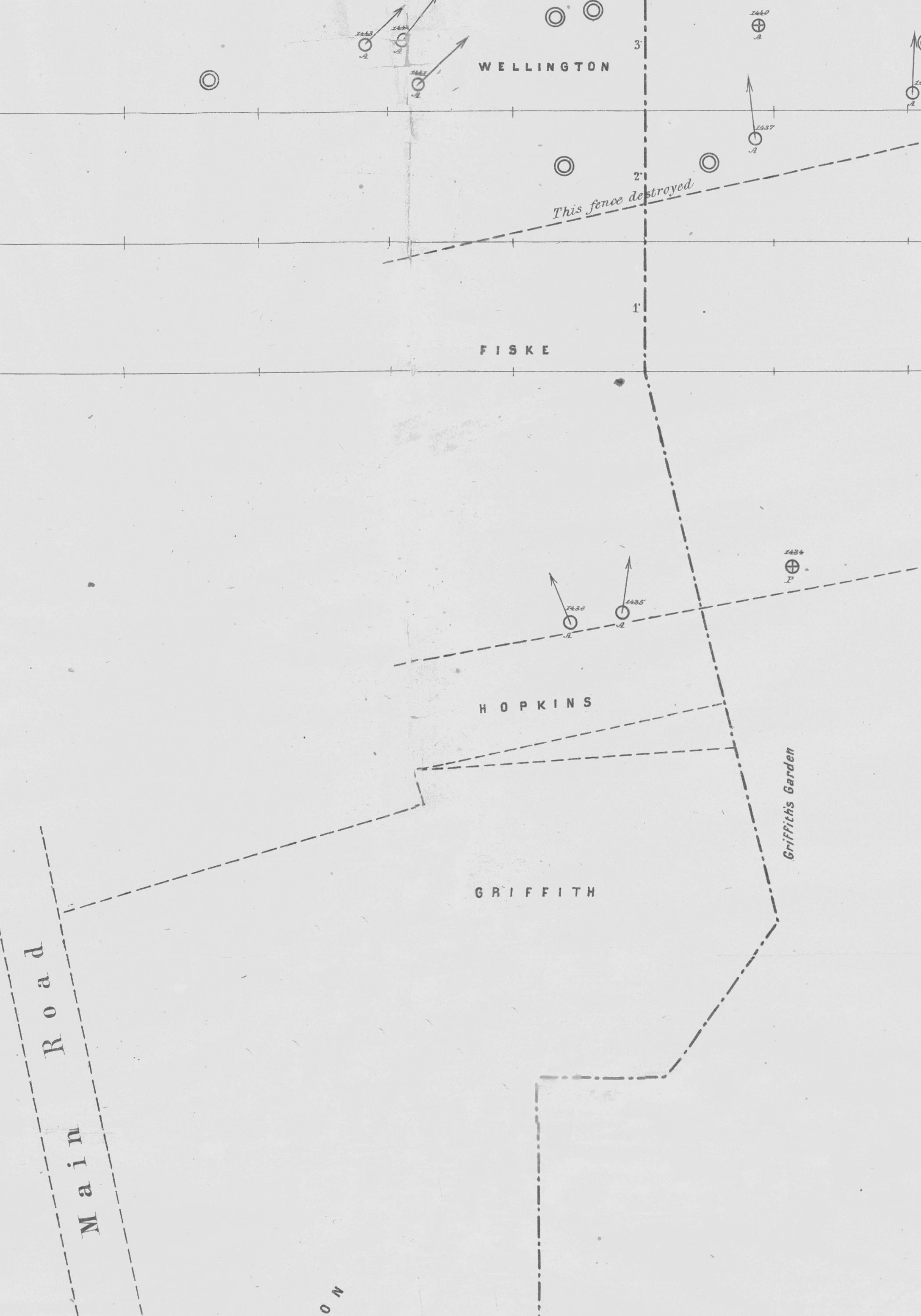
1489
ICE HOUSE
ICE HOUSE
blown down
1479
A
D
N

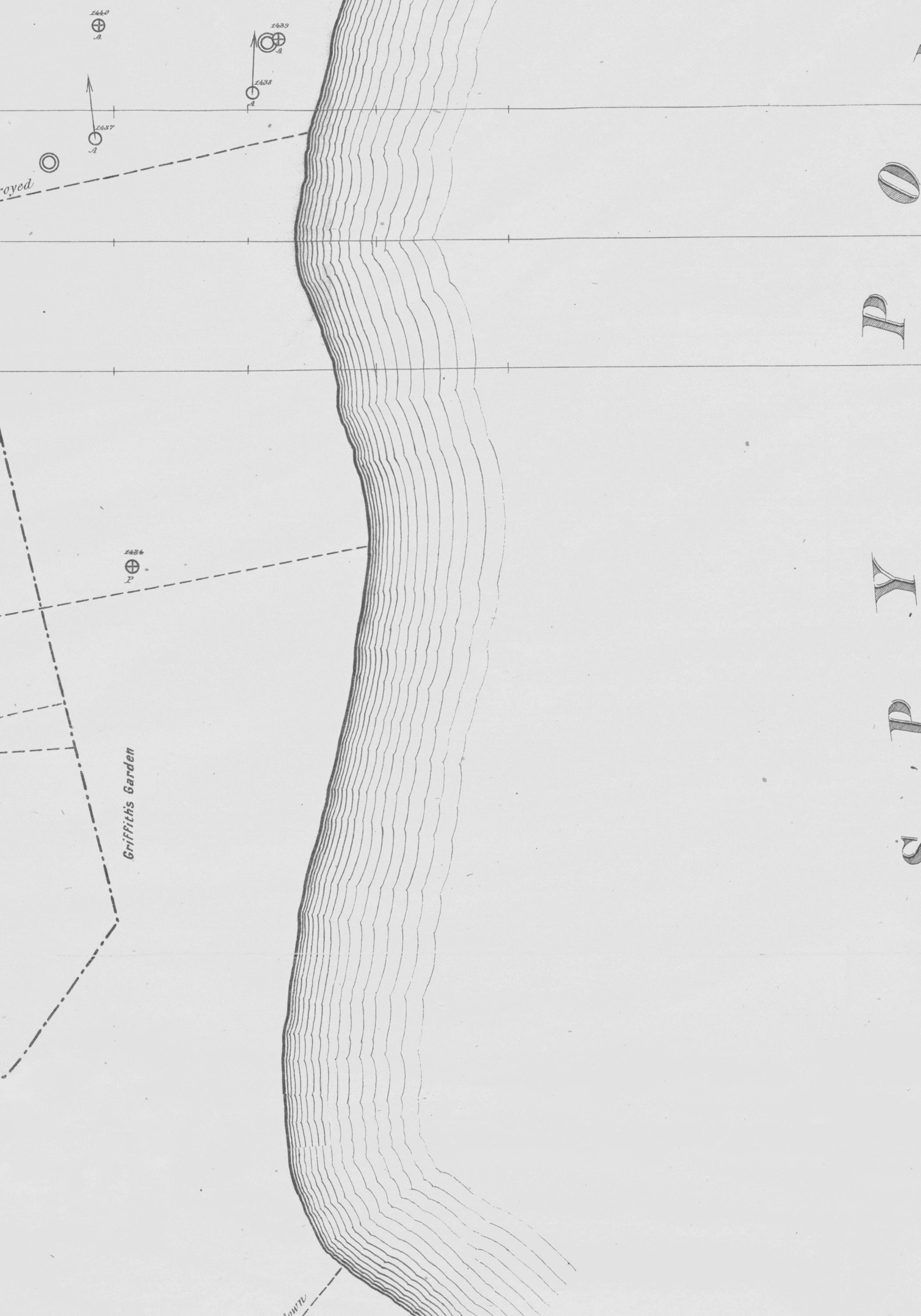
2½ miles

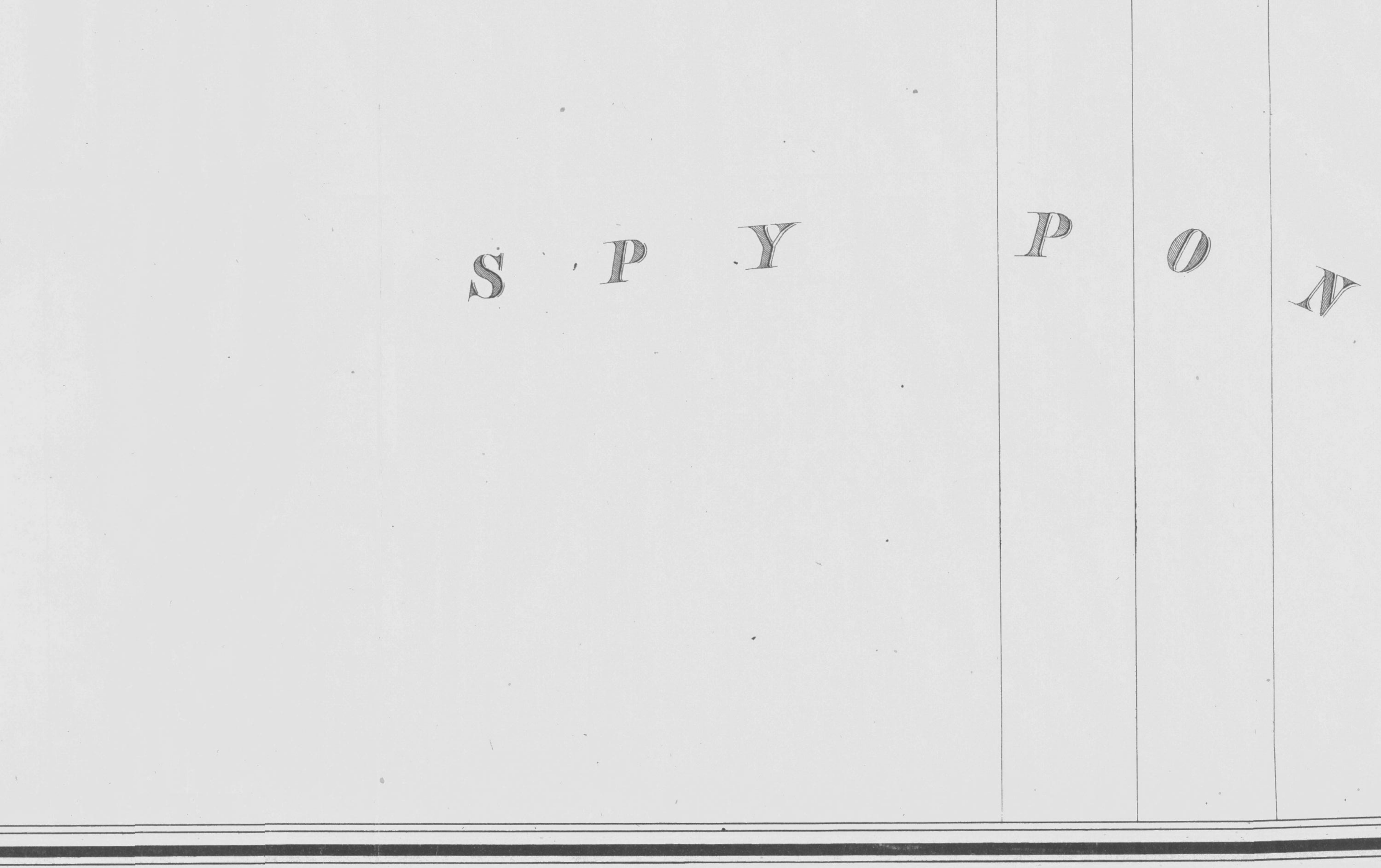
13000 feet

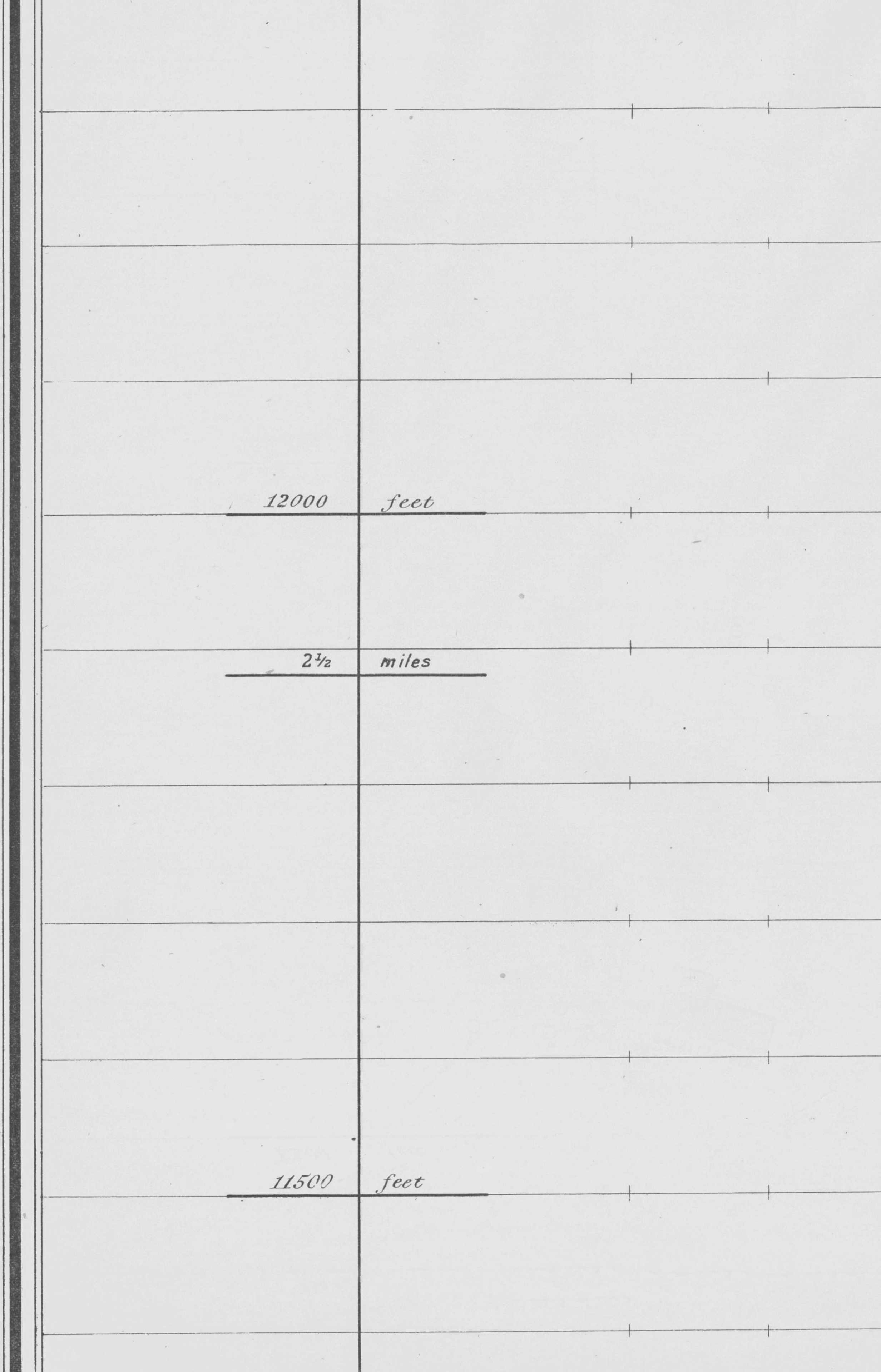
12500 feet


Main Road

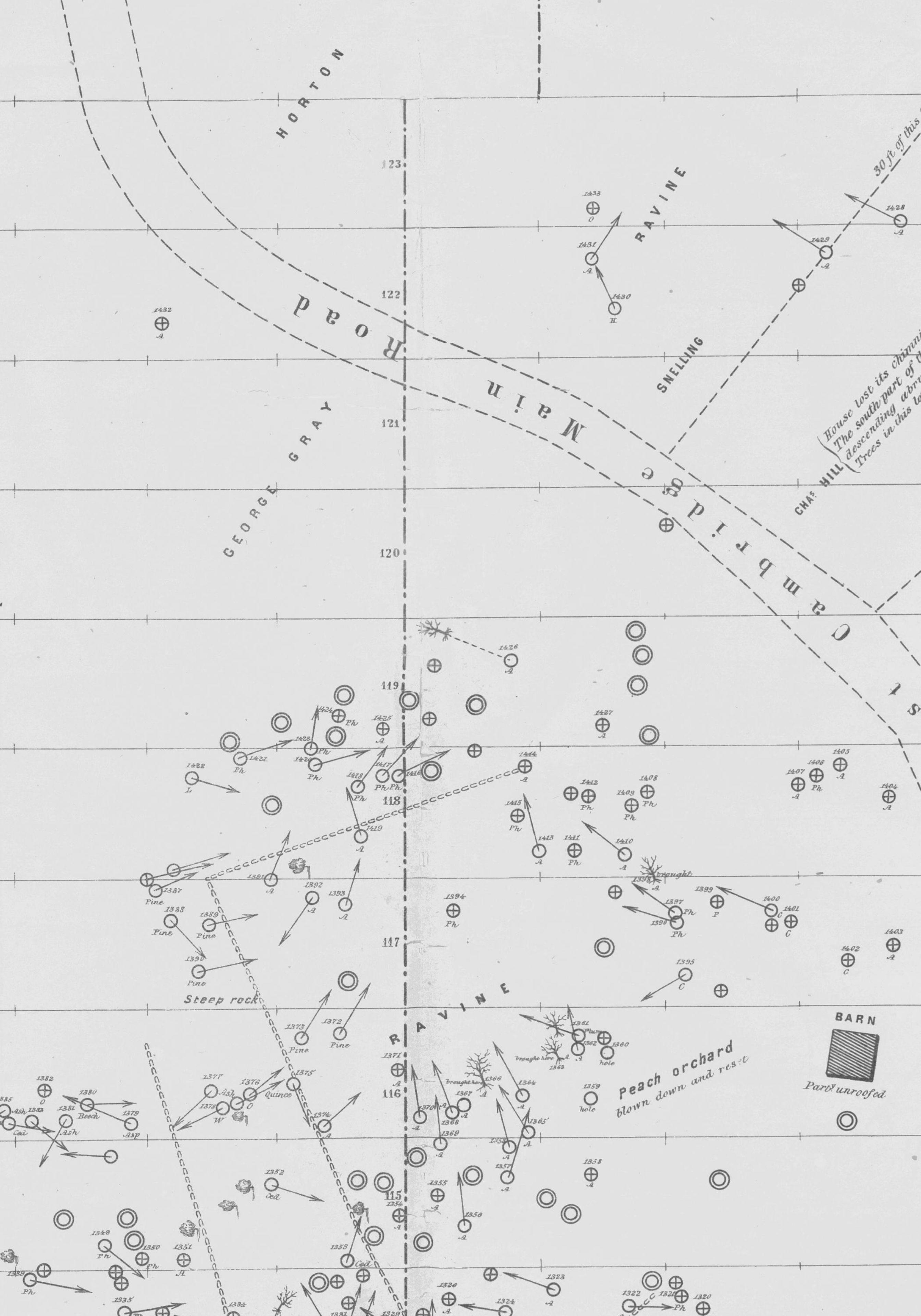

1443
1442
1441
1440
WELLINGTON
3
A
1437
2
This fence destroyed
1
FISKE
1434
P
1436
1435
HOPKINS
Griffiths Garden
GRIFFITH
Main Road
ON

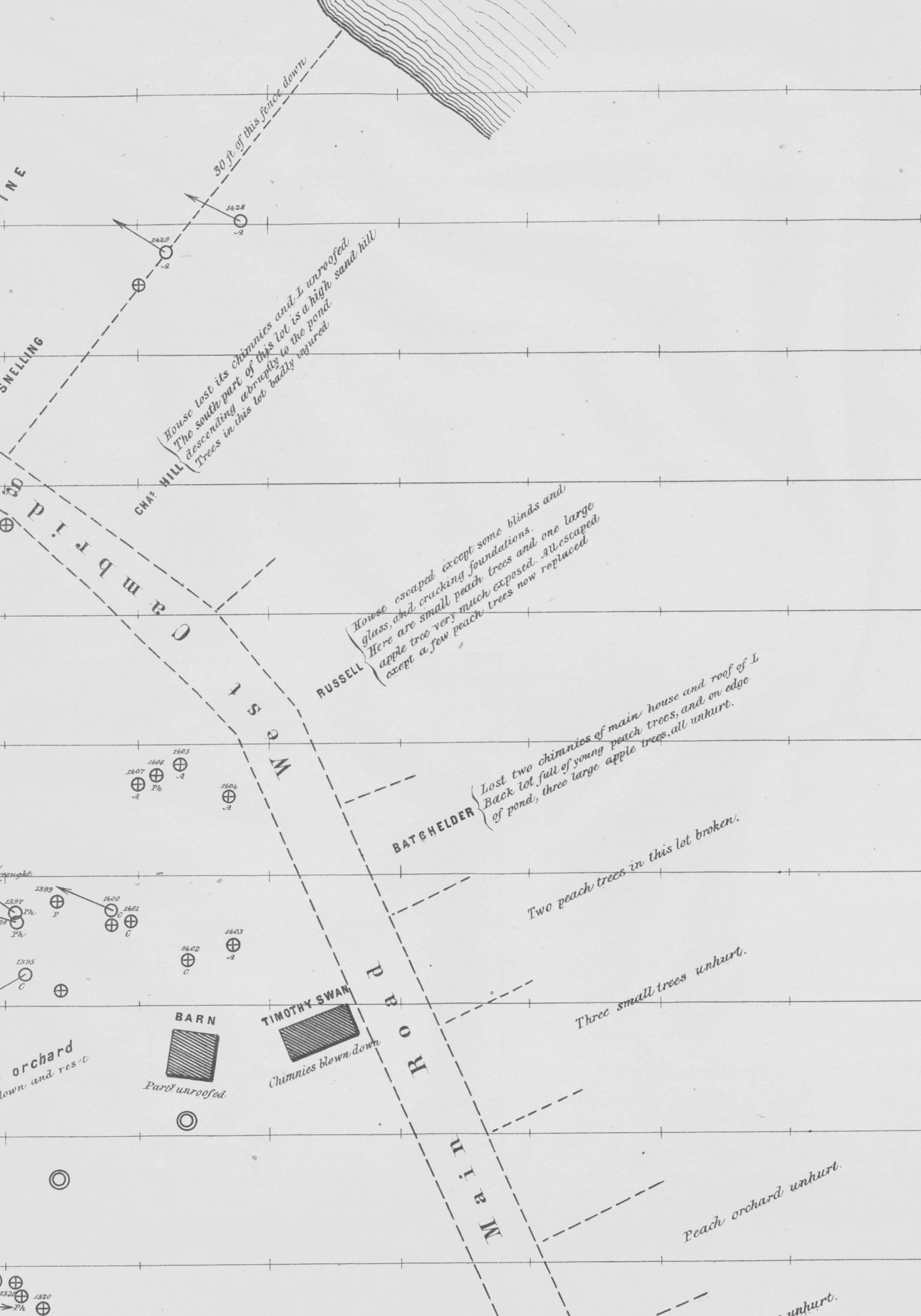

1440
A
1439
A
1438
A
1437
A
royed
1434
P
Griffiths Garden
own
S P Y P O

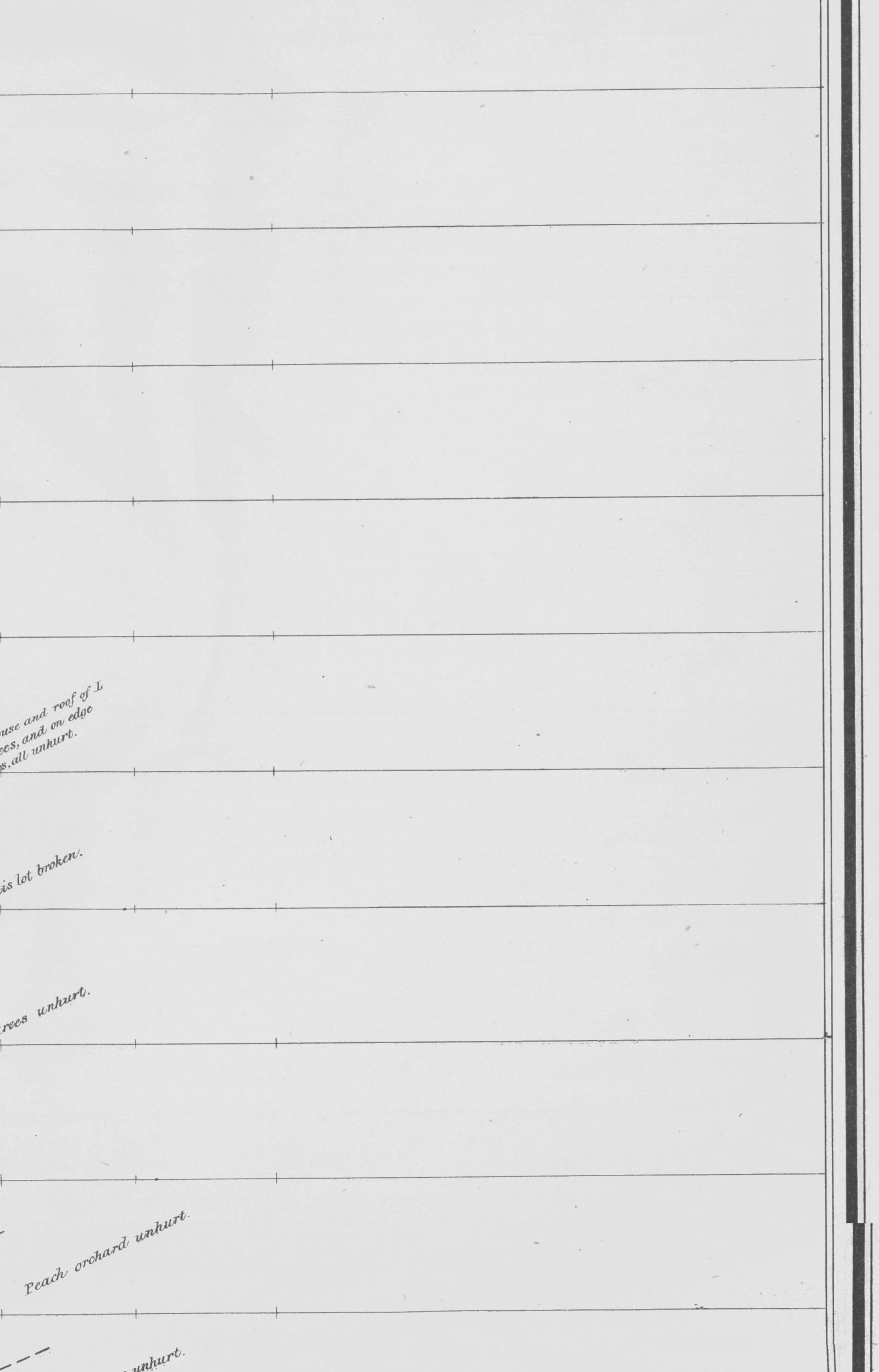

SPY
PON

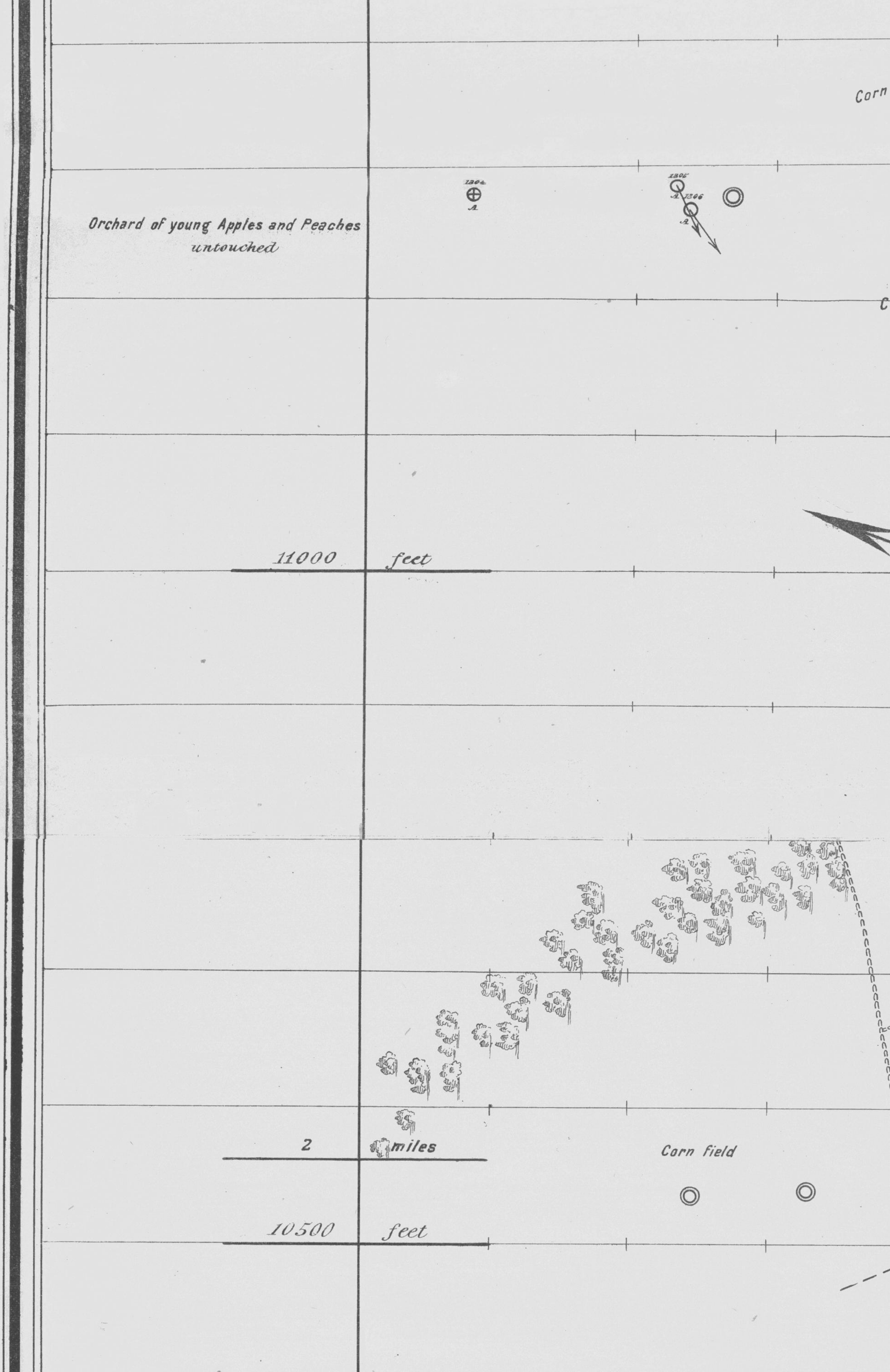

12000 feet
2½ miles
11500 feet

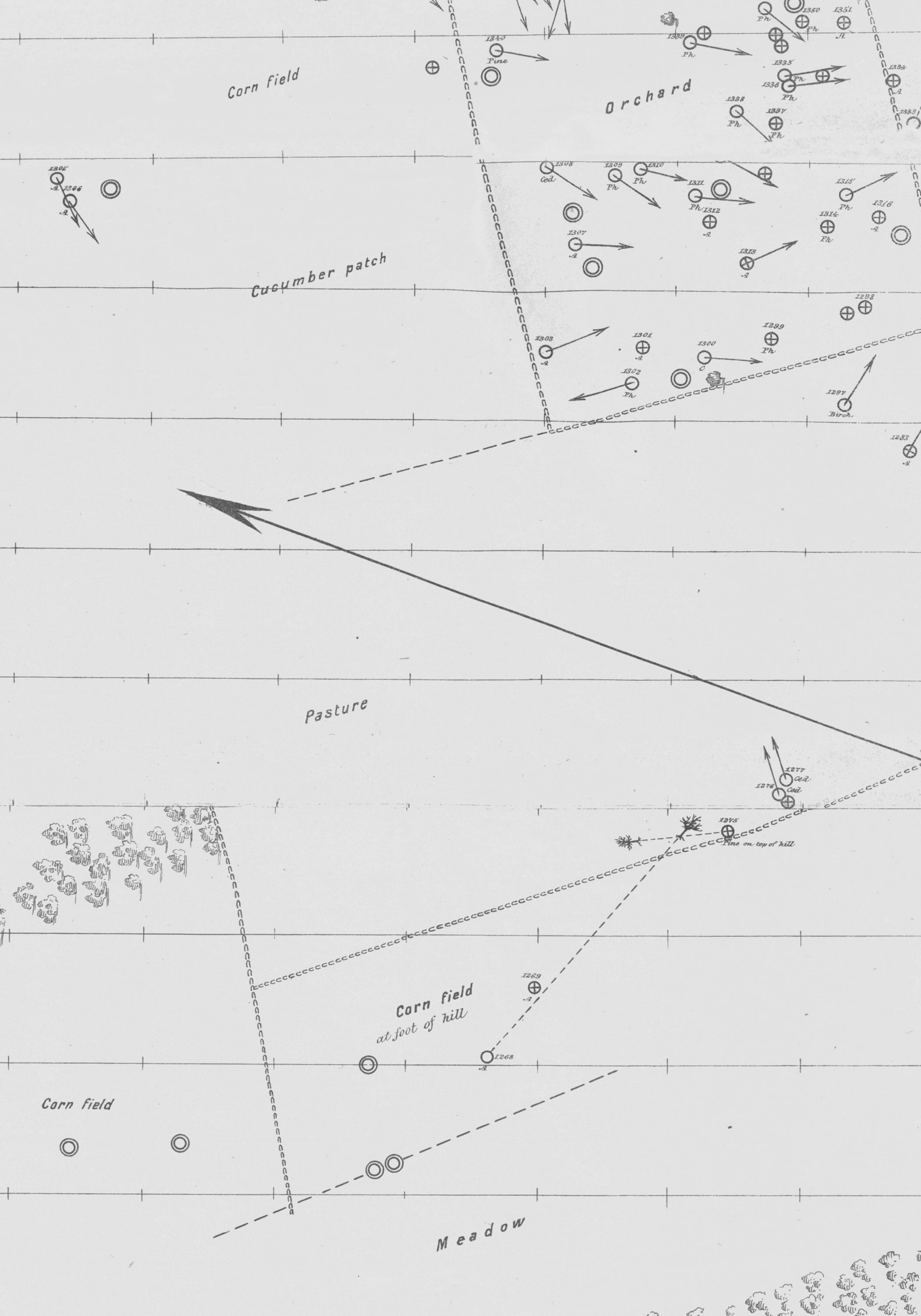
1432
A
GEOR
1422
L
Ph
1387
Pine
1388
Pine
1389
Pine
1390
Pine
Steep rock
1386
scorched
H
1382
O
1385
Ash
1384
Ced
1383
1381
Ash
1380
Beech
1379
Asp
1377
Ash
1376
O
1378
W
1342
Ced
1343
Pine
1341
Ced
1344
Ced
1346
Ced
1345
Ced
1347
Ced.
1348
Ced
1340
Pine
1349
Ph
1350
Ph
1351
A
1339
Ph
1335
1334
ield

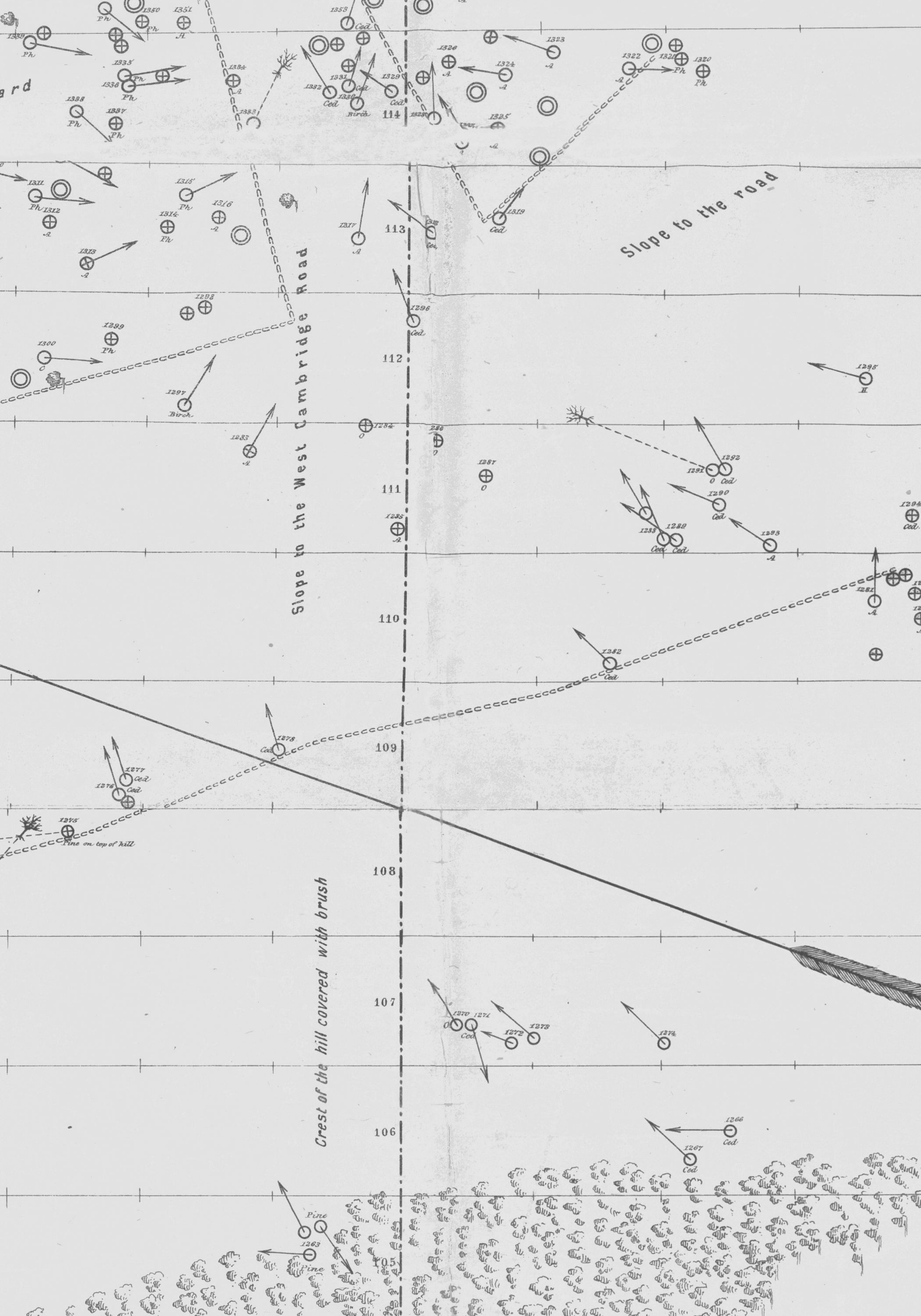

HORTON
RAVINE
Main Road
Cambridge St
GEORGE GRAY
SNELLING
CHAS. HILL
House lost its chimn
The south part of t
descending abru
Trees in this lo
30 ft of this
123
122
121
120
119
118
117
116
115
1433 O
1431 A
1430 H
1429 A
1428 A
1432 A
1426 A
1427 A
1425 A
1424 Ph
1423 Ph
1422 L
1421 Ph
1420 Ph
1419 A
1418 Ph
1417 Ph
1416 Ph
1415 Ph
1414 A
1413 A
1412 Ph
1411 Ph
1410 A
1409 Ph
1408 Ph
1407 A
1406 Ph
1405 A
1404 A
1403 A
1402 C
1401 C
1400 C
1399 P
1398 A
1397 Ph
1396 Ph
1395 C
1394 Ph
1393 A
1392 A
1391 A
1390 Pine
1389 Pine
1388 Pine
1387 Pine
brought
Steep rock
1373 Pine
1372 Pine
1371 A
1370 A
1369 A
1368 A
1367 A
1366 A
1365 A
1364 A
1363
1362 A
1361 Plum
1360 hole
1359 hole
1358 A
1357 A
1356 A
1355 A
1354 A
1353 Ced
1352 Ced
1351 A
1350 Ph
1349 Ph
1348 Ph
1377 Ash
1376 O
1375 Quince
1374 A
1378 W
1382 O
1380 Beech
1379 Asp
1381 Ash
1383 Ash
1385 Ced
1335
1334
1331
1329
1326 A
1324 A
1323 A
1322
1321 Ph
1320 Ph
brought here
Peach orchard
blown down and reset
BARN
Partly unroofed

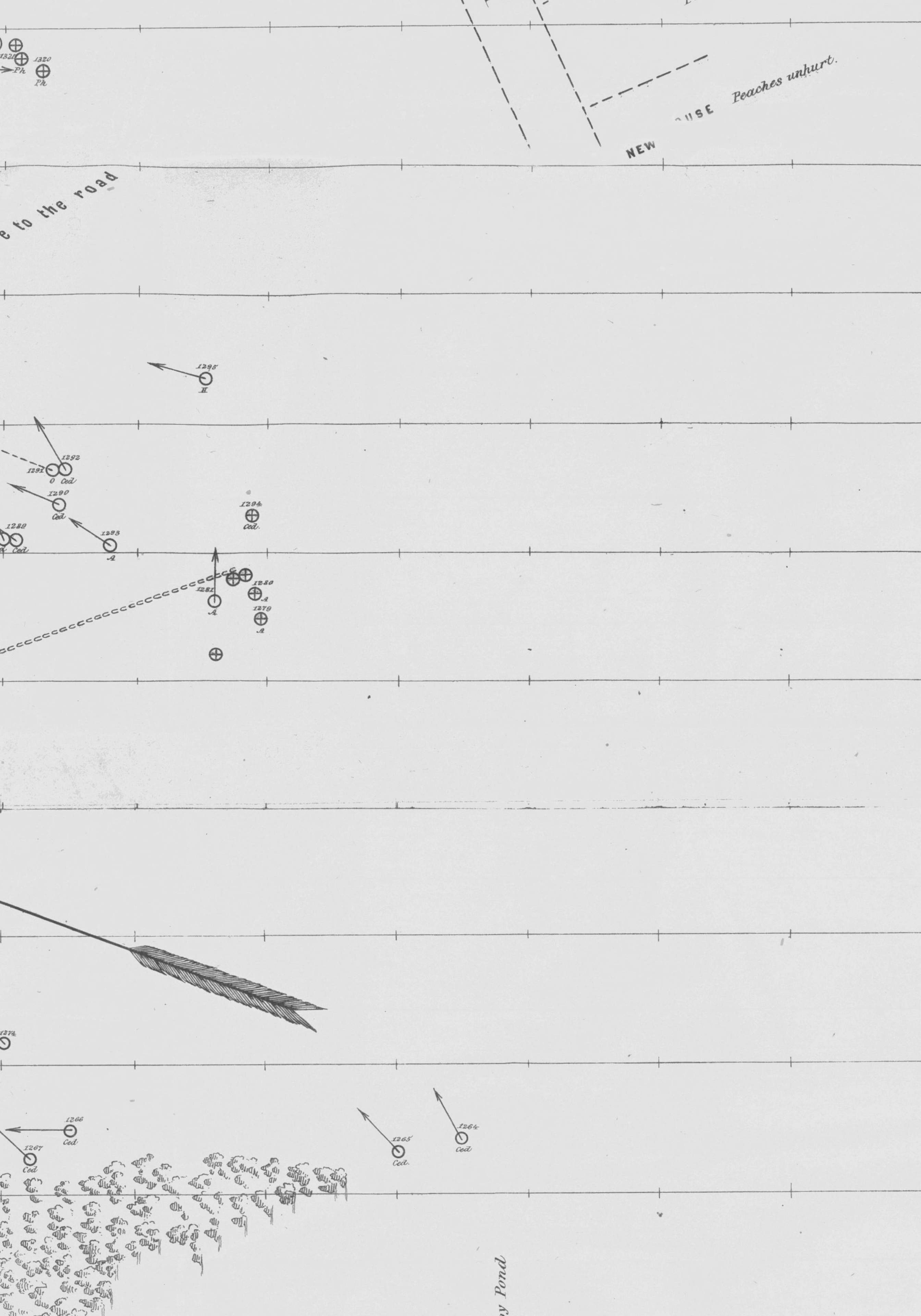

INE
30 ft of this fence down
1428
A
1429
A
SNELLING
CHAS. HILL
House lost its chimnies and L unroofed
The south part of this lot is a high sand hill
descending abruptly to the pond
Trees in this lot badly injured
West Cambridge
RUSSELL
House escaped except some blinds and
glass, and cracking foundations.
Here are small peach trees and one large
apple tree very much exposed. All escaped
except a few peach trees now replaced
1405
A
1406
Ph
1407
A
1404
A
BATCHELDER
Lost two chimnies of main house and roof of L
Back lot full of young peach trees, and on edge
of pond, three large apple trees, all unhurt.
rought
1399
P
1400
C
1401
C
1397
Ph
Ph
1403
A
1402
C
1395
C
Two peach trees in this lot broken.
Three small trees unhurt.
BARN
Partly unroofed
TIMOTHY SWAN
Chimnies blown down
orchard
down and reset
Main Road
Peach orchard unhurt.
1321
Ph
1320
unhurt.


use and roof of L
ees, and on edge
s, all unhurt.
is lot broken.
rees unhurt.
Peach orchard unhurt.
unhurt.

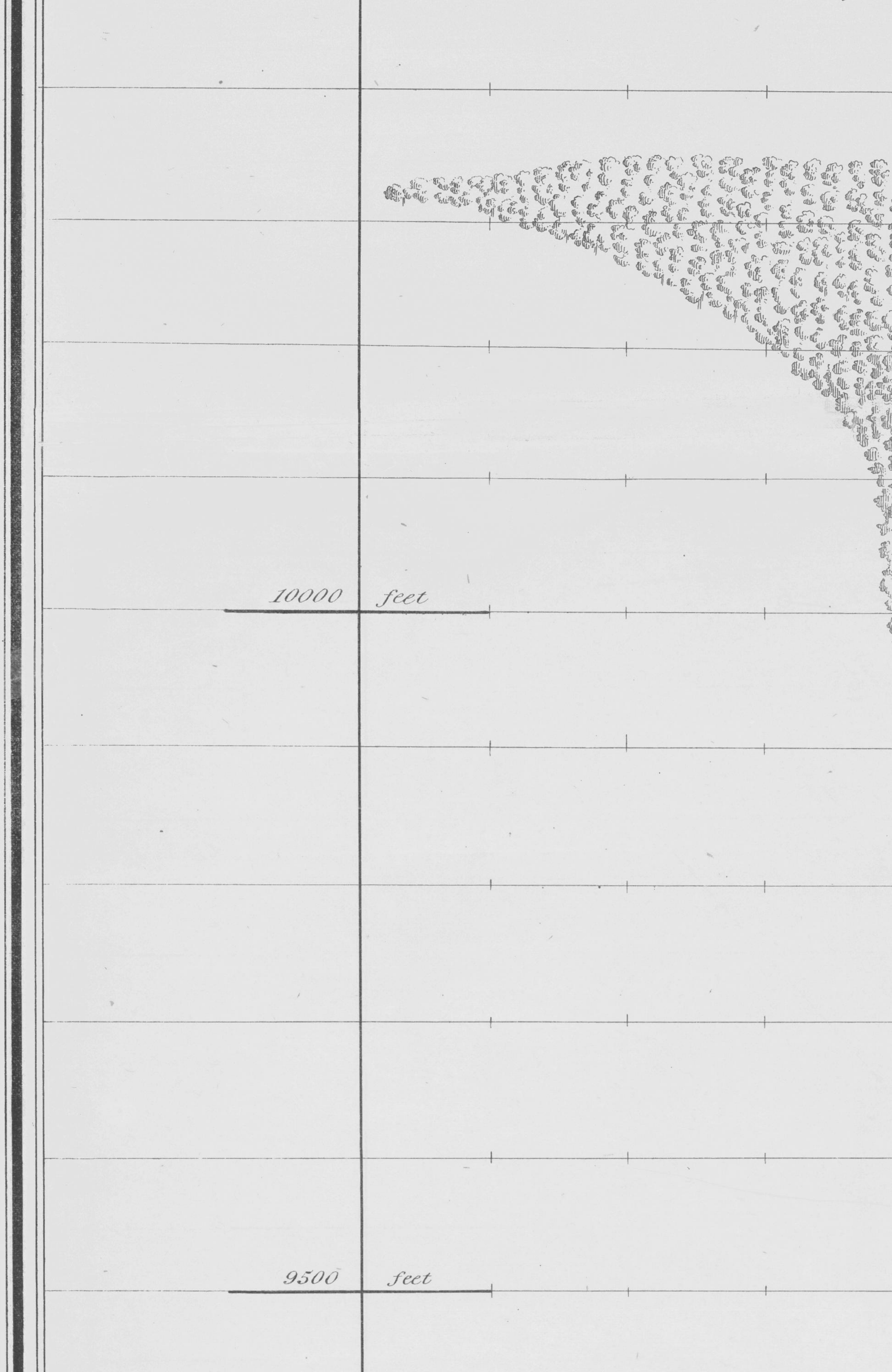

Corn
Orchard of young Apples and Peaches untouched
1304
A
1305
A
1306
A
C
11000 feet
2 miles
Corn Field
10500 feet

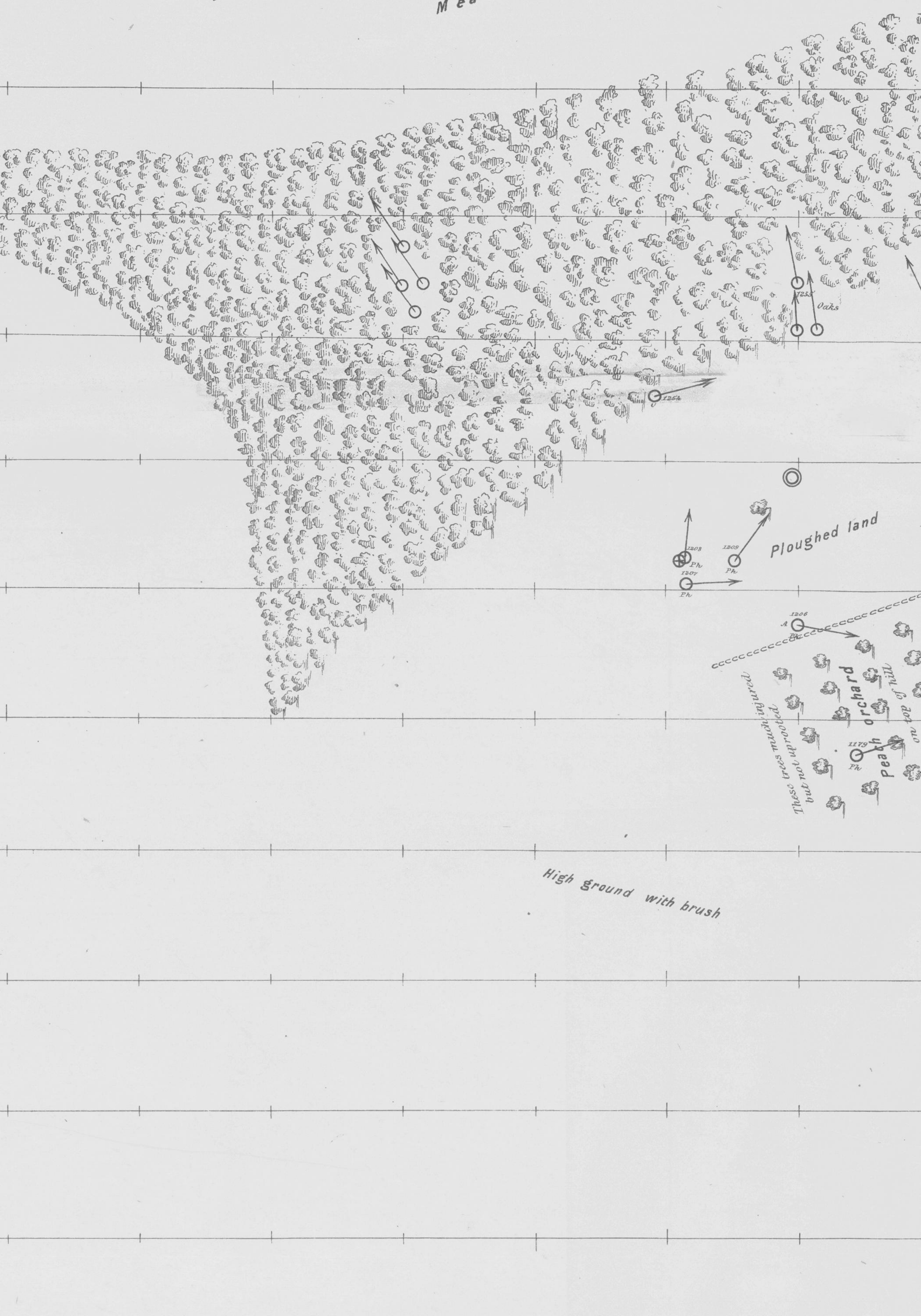

1350
1351
Ph
Ph
A
1339
Ph
1340
Pine
Corn field
Orchard
1335
Ph
1336
Ph
1334
A
1338
Ph
1337
Ph
1333
1305
A
1306
A
1308
Ced
1309
Ph
1310
Ph
1311
Ph
1312
A
1315
Ph
1316
A
1314
Ph
1307
A
1313
A
Cucumber patch
1298
1299
Ph
1303
A
1301
A
1300
C
1302
Ph
1297
Birch
1283
A
Pasture
1277
Ced
1276
Ced
1275
Pine on top of hill
1269
A
Corn field
at foot of hill
1268
A
Corn field
Meadow

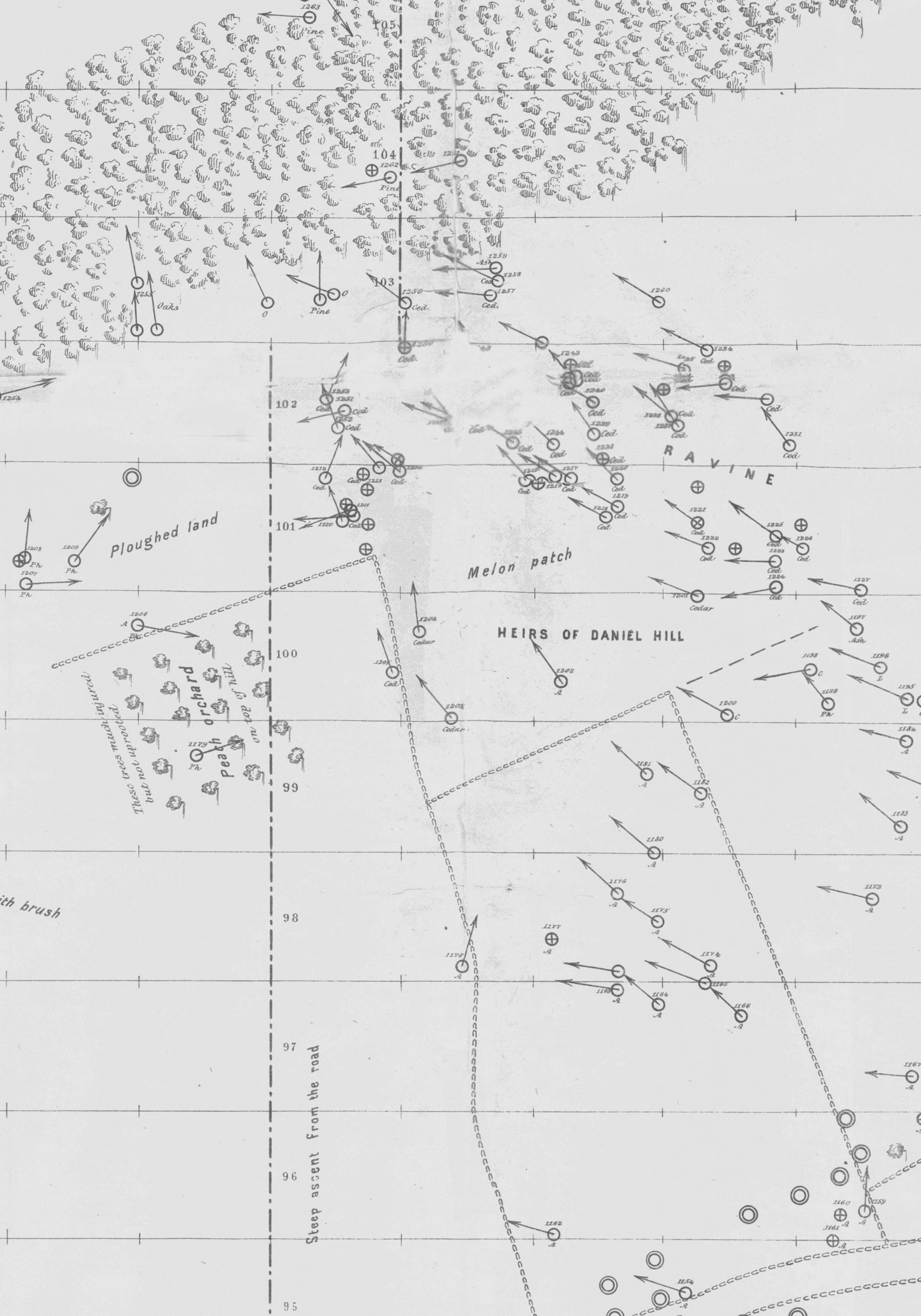

ard
Slope to the West Cambridge Road
Slope to the road
Crest of the hill covered with brush
Pine on top of hill
114
113
112
111
110
109
108
107
106
105
1350
1351
1353
1339
1335
1336
1338
1337
1334
1333
1332
1331
1330
1329
1326
1323
1324
1325
1322
1321
1320
1311
1312
1315
1314
1316
1313
1317
1319
1298
1299
1300
1297
1296
1295
1284
1286
1287
1283
1285
1291
1292
1290
1288
1289
1293
1294
1281
1282
1278
1277
1276
1275
1270
1271
1272
1273
1274
1266
1267
1263
Ph
A
Ced
Birch
O
C
H
Pine

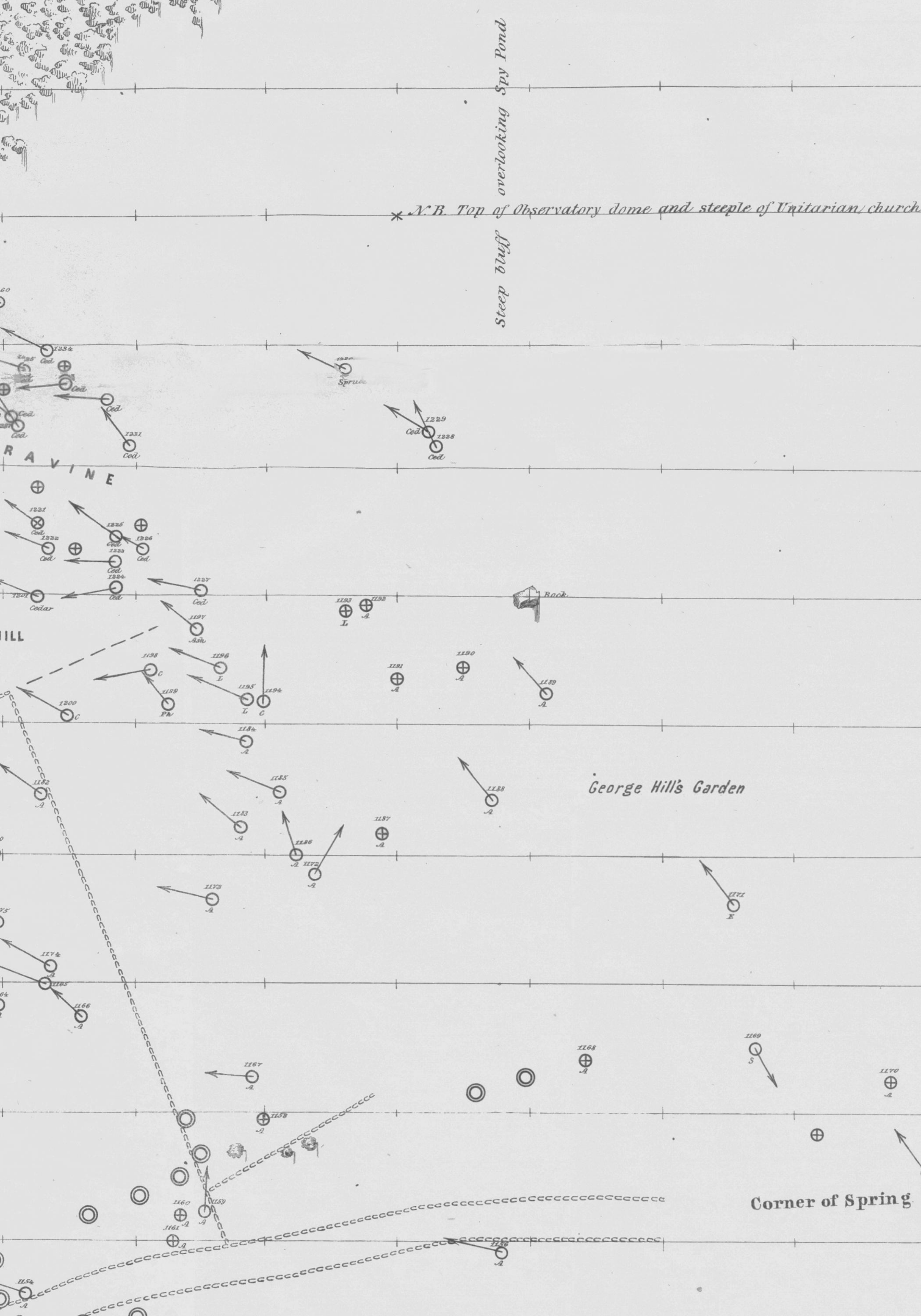

1321
Ph
1320
Ph
NEW HOUSE
Peaches unhurt.
e to the road
1295
H
1292
1291
0
Ced
1290
Ced
1288
Ced
1293
A
1294
Ced.
1281
A
1280
A
1279
A
1274
1266
Ced
1267
Ced
1265
Ced.
1264
Ced
y Pond

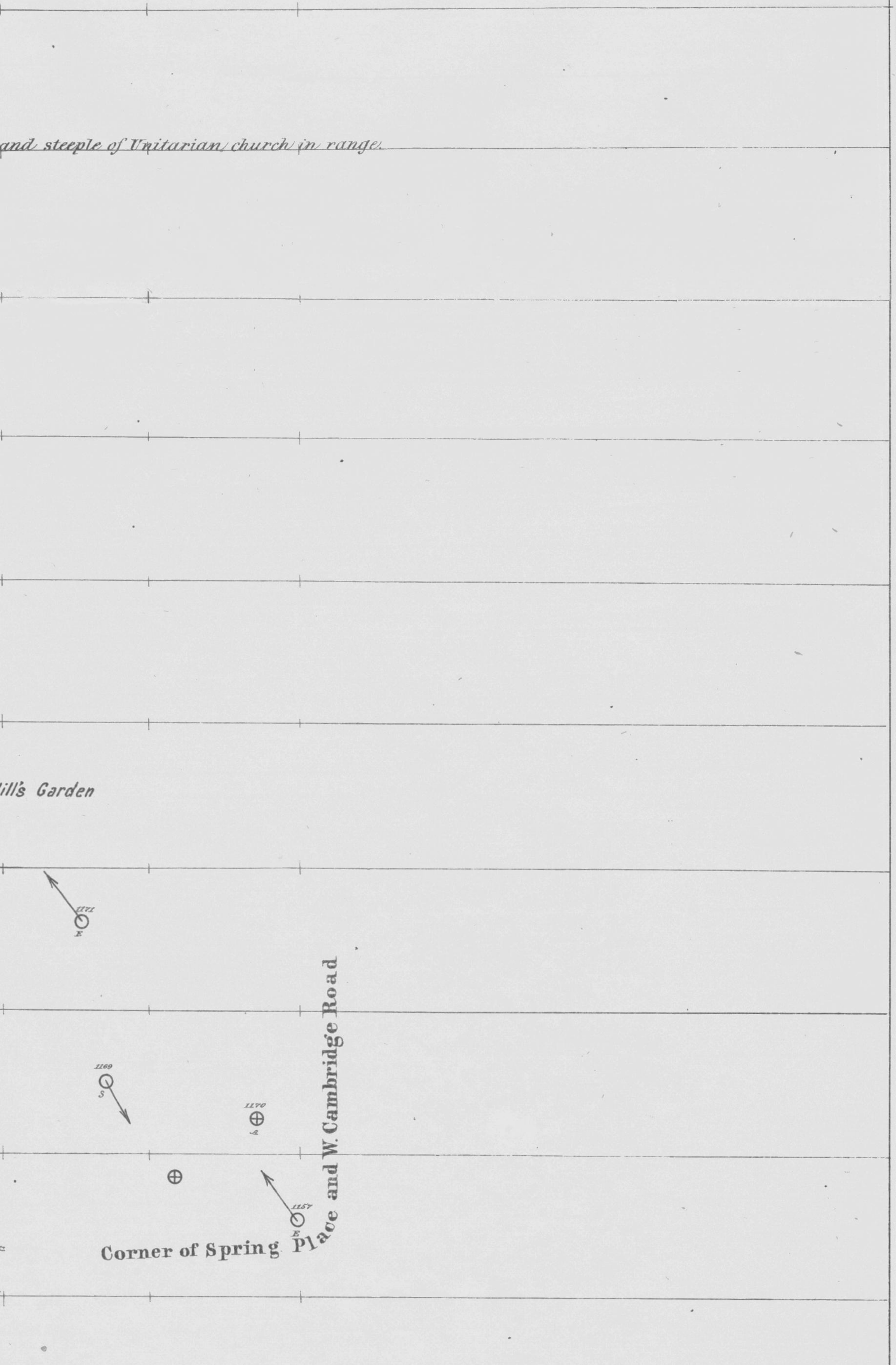
USE Peaches unhurt.

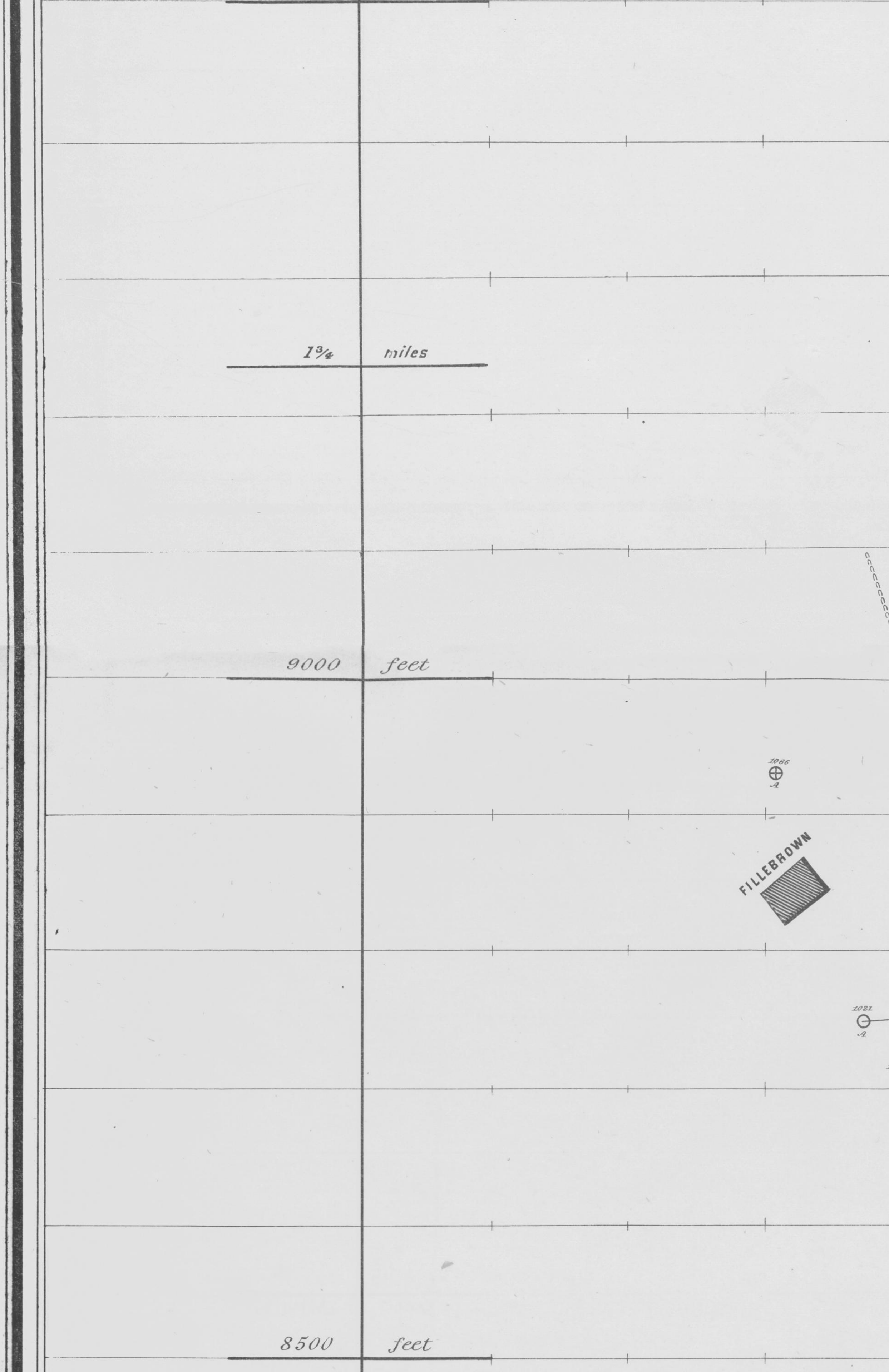

10000 feet
9500 feet

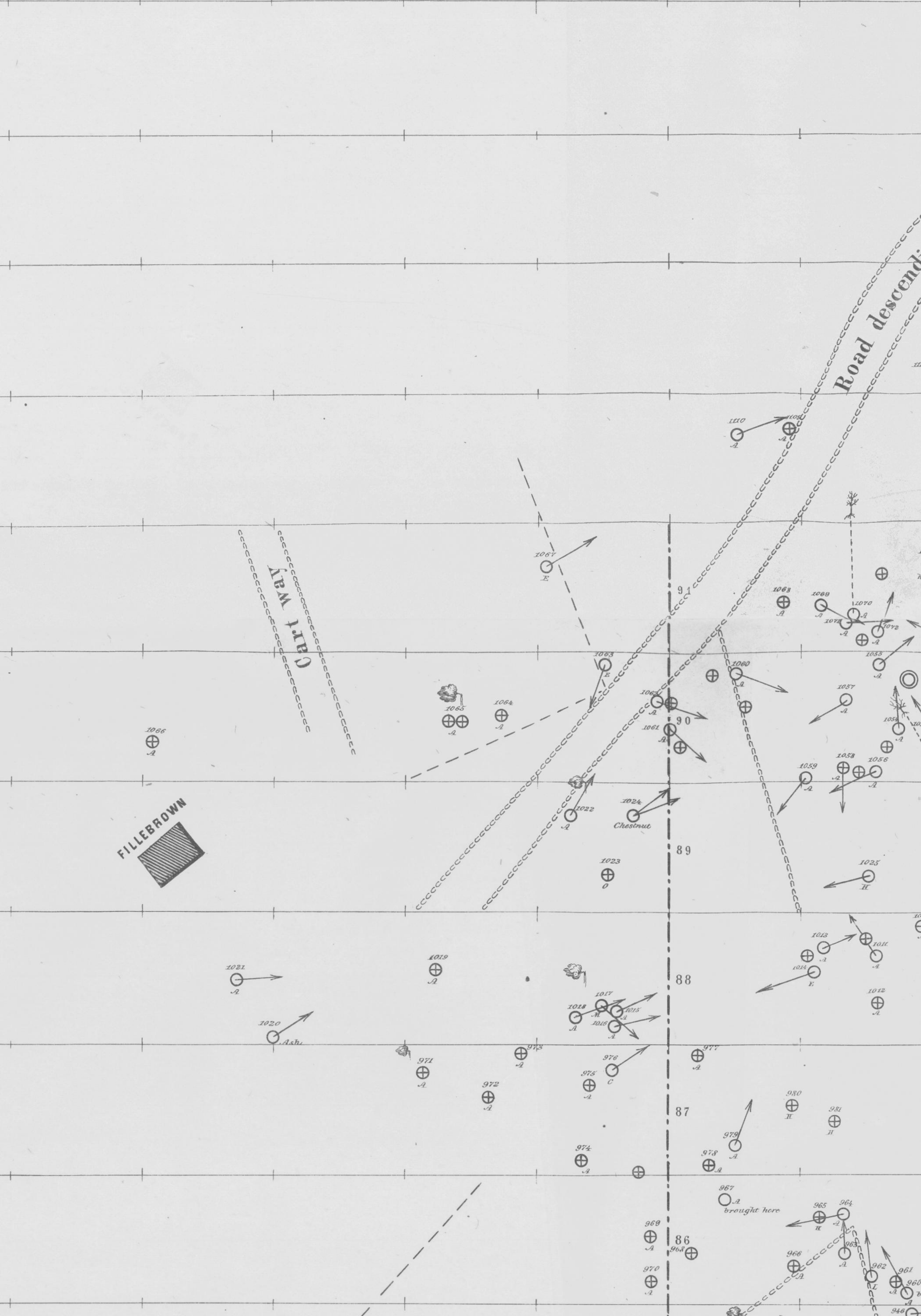

Mea
1255
Oaks
1254
1208
Ph
1209
Ph
1207
Ph
Ploughed land
1206
A
Ph
These trees much injured
but not uprooted
Peach orchard
on top of hill
1179
Ph
High ground with brush

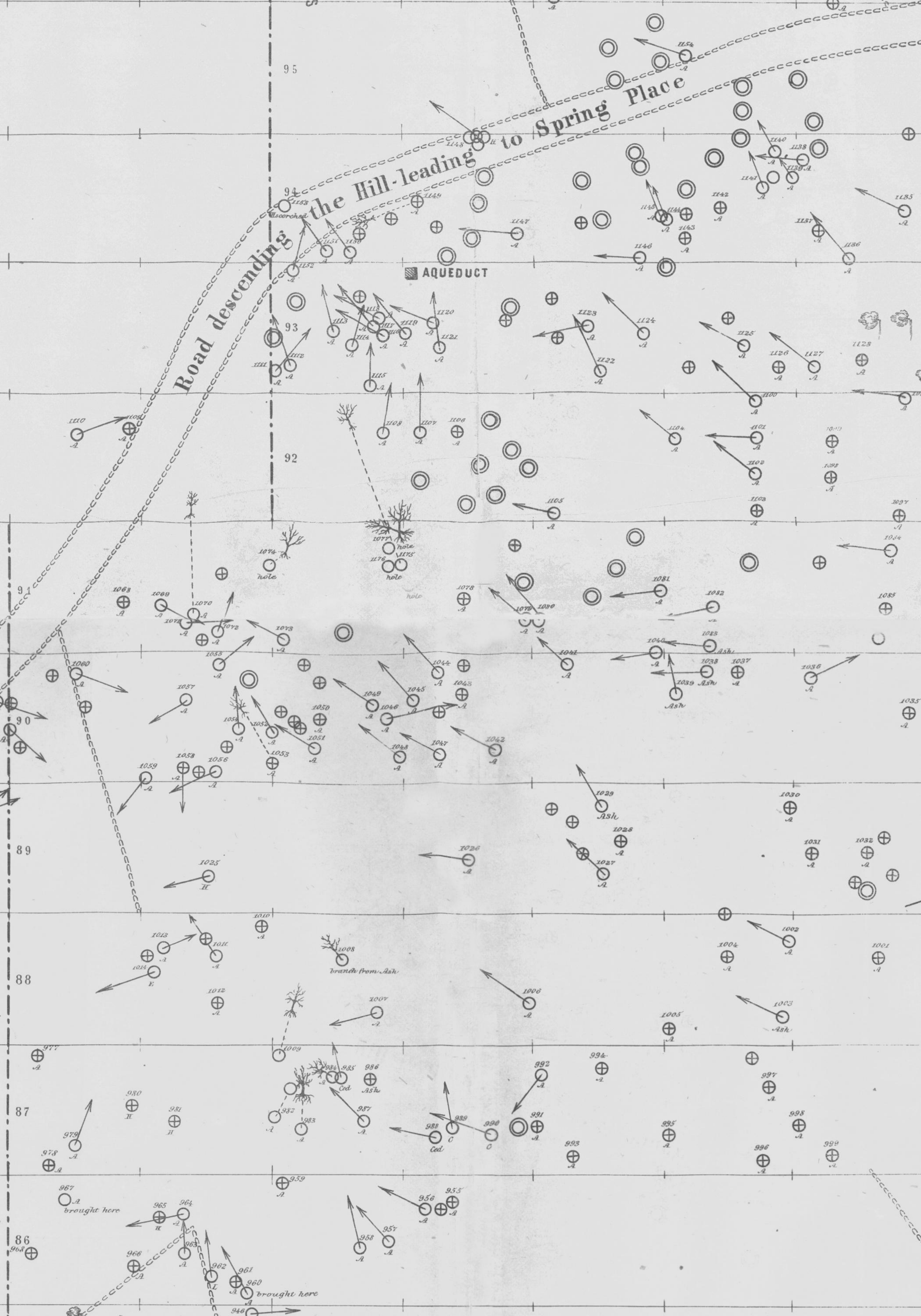

105
104
103
102
101
100
99
98
97
96
95
1263
Pine
1262
Pine
1261
Oaks
O
Pine
O
1259
Ash
1258
Ced
1257
Ced
1256
Ced.
1250
Ced.
1260
1254
1253
1251
Ced
1252
Ced
1243
Ced
Ced
1240
Ced
1239
Ced
1238
Ced
1244
Ced
1245
Ced
1234
Ced
1235
Ced
1236
Ced
1237
Ced
1231
Ced
RAVINE
1212
Ced
1213
Ced
1214
Ced
1211
1210
Ced
1215
Ced
1216
1217
Ced
1220
Ced
1219
Ced
1218
Ced
1221
Ced
1222
Ced
1225
Ced
1226
Ced
1223
Ced
1224
Ced
1201
Cedar
1227
Ced
1197
Ash
1208
Ph
1209
Ph
1207
Ph
Ploughed land
Melon patch
HEIRS OF DANIEL HILL
1206
A
Ph
1204
Cedar
1205
Ced
1203
Cedar
1202
A
1198
C
1199
Ph
1196
L
1195
L
1200
C
1184
A
These trees much injured but not uprooted
Peach orchard on top of hill
1179
Ph
1181
A
1182
A
1183
A
1180
A
1176
A
1175
A
1173
A
ith brush
1177
A
1178
A
1174
A
1165
1163
A
1164
A
1166
A
1167
A
Steep ascent from the road
1160
A
1159
A
1161
A
1162
A
1154
A


Steep bluff overlooking Spy Pond
N.B. Top of Observatory dome and steeple of Unitarian church
RAVINE
HILL
Rock
George Hill's Garden
Corner of Spring
1234 Ced
1230 Spruce
1229 Ced
1228 Ced
1231 Ced
Ced
1221 Ced
1222 Ced
1225 Ced
1226 Ced
1223 Ced
1224 Ced
1201 Cedar
1227 Ced
1197 Ash
1193 L
1192 A
1198 C
1196 L
1199 Ph
1195 L
1194 C
1200 C
1191 A
1190 A
1189 A
1184 A
1182 A
1185 A
1183 A
1188 A
1187 A
1186 A
1172 A
1171 E
1173 A
1174 A
1165
1166 A
1167 A
1158 A
1168 A
1169 S
1170 A
1160 A
1159 A
1161 A
1156 A
1154 A

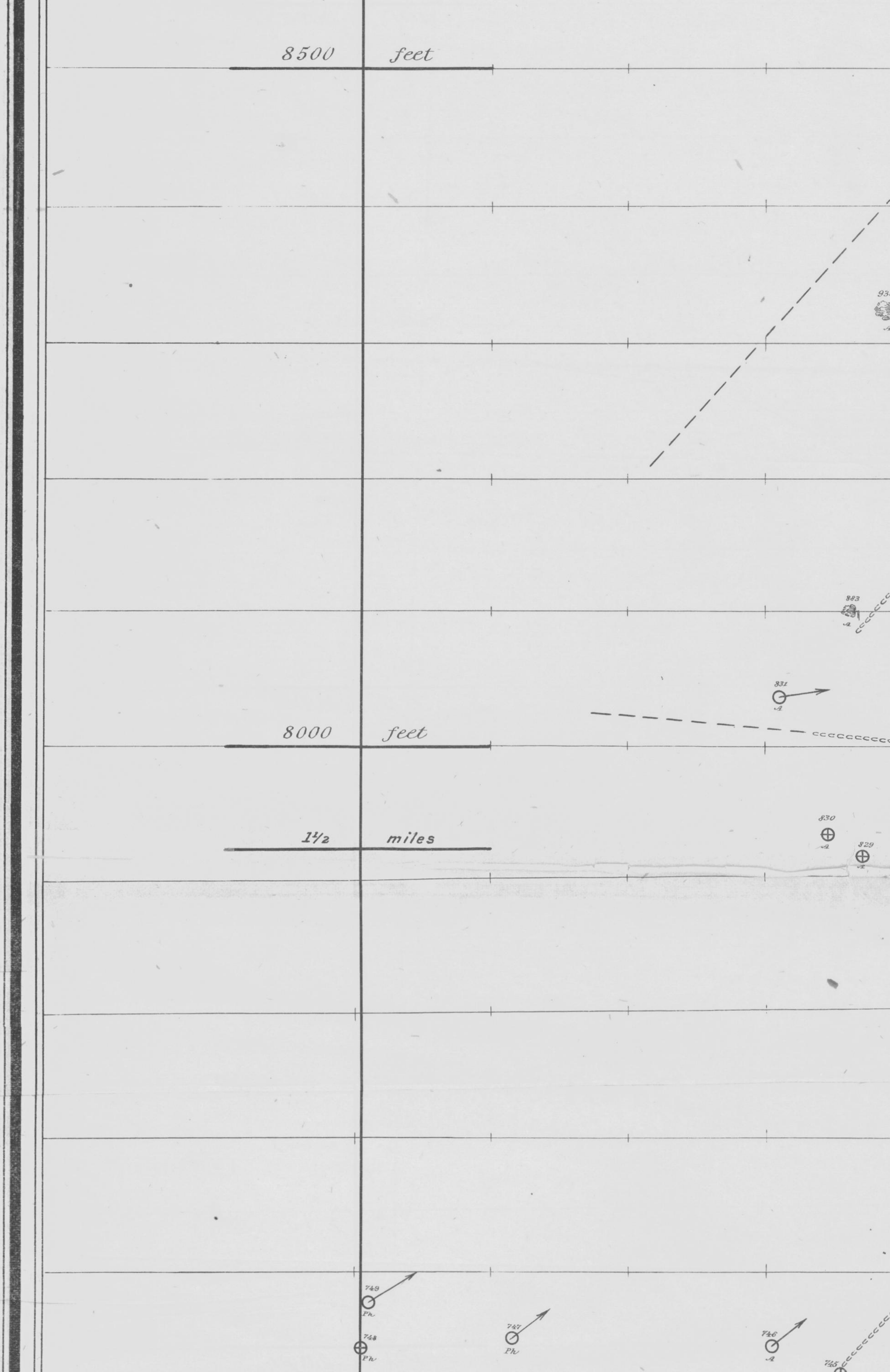

and steeple of Unitarian church in range.
ill's Garden
1171
E
1169
S
1170
A
1157
E
Corner of Spring Place and W. Cambridge Road

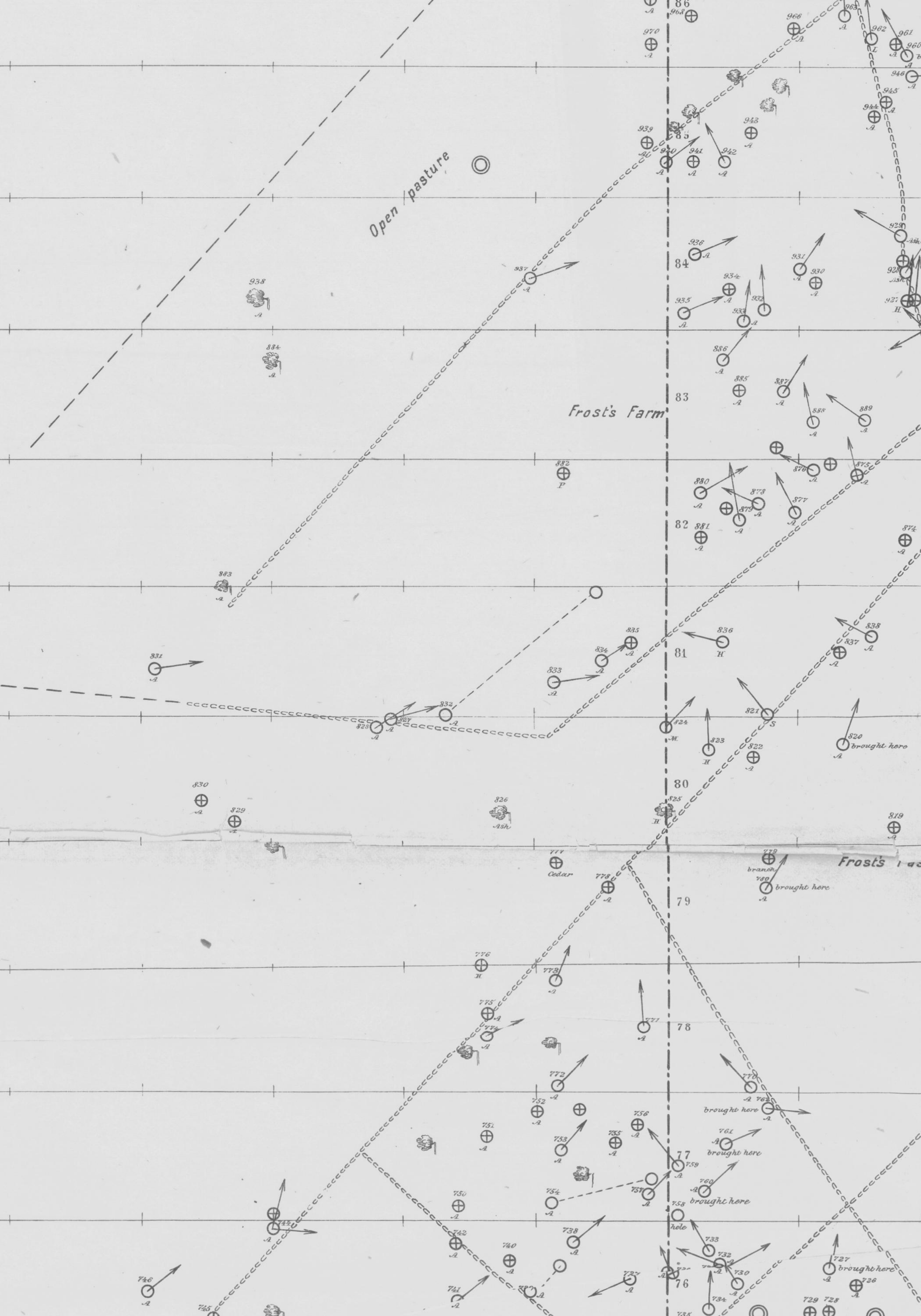

1¾ miles
9000 feet
1066
A
FILLEBROWN
1021
A
8500 feet

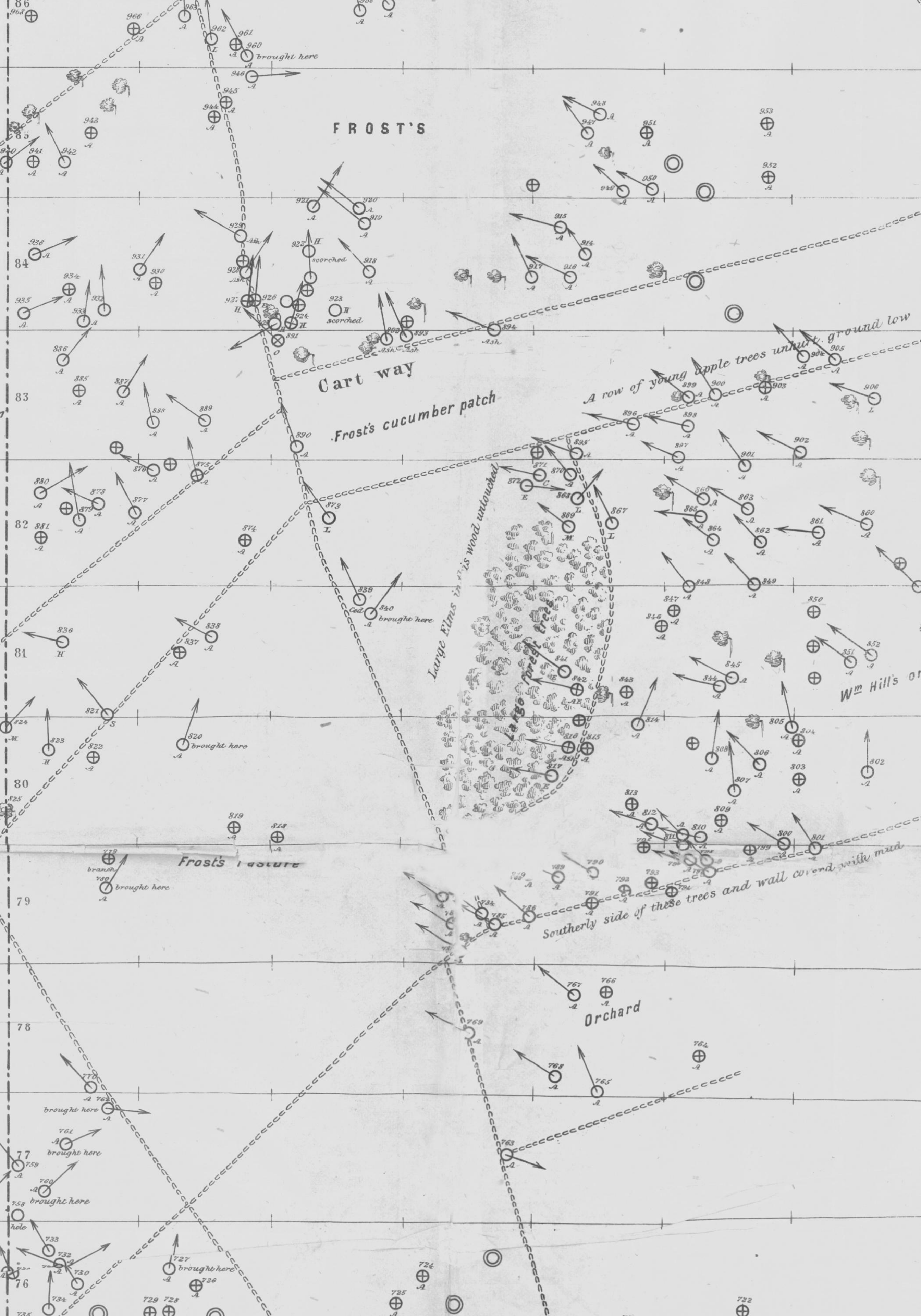

Road descend
Cart way
FILLEBROWN
91
90
89
88
87
86
1110 A
1109 A
1067 E
1068 A
1069 A
1070 A
1071 A
1072
1055 A
1057 A
1060 A
1063 E
1062 A
1061 A
1064 A
1065 A
1066 A
1058 A
1056 A
1059 A
1022 A
1024 Chestnut
1023 O
1025 H
1013 A
1011 A
1014 E
1012 A
1021 A
1019 A
1020 Ash
1017 M
1018 A
1015 A
1016 A
971 A
973 A
972 A
975 A
976 C
977 A
980 H
981 H
979 A
978 A
974 A
967 A brought here
965 H
964 A
963 A
966 A
969 A
968
970 A
962 L
961 A
960
946

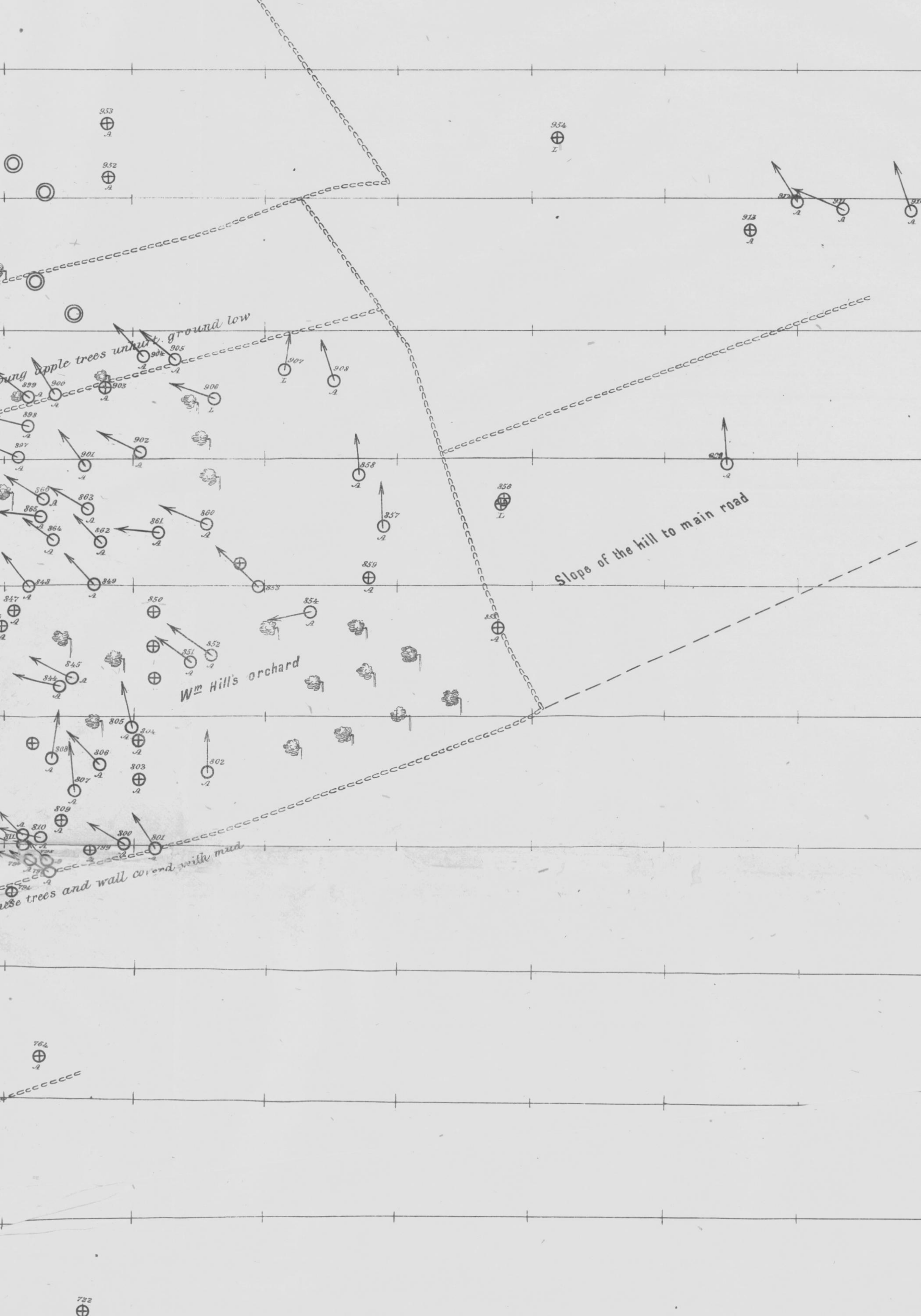

Road descending the Hill-leading to Spring Place
AQUEDUCT
95
94
93
92
91
90
89
88
87
86
1154
1153
scorched
1152
1151
1150
1149
1148
1147
1146
1145
1144
1143
1142
1141
1140
1139
1138
1137
1136
1135
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
1114
1113
1112
1111
1128
1127
1126
1125
1110
1109
1108
1107
1106
1105
1104
1103
1102
1101
1100
1099
1098
1097
1094
1085
1083
1082
1081
1080
1079
1078
1077
hole
1176
1175
hole
1074
hole
1073
1072
1071
1070
1069
1068
1060
1058
1057
1056
1055
1054
1053
1052
1051
1050
1049
1048
1047
1046
1045
1044
1043
1042
1041
1040
1039
1038
1037
1036
1035
1033
1032
1031
1030
1029
1028
1027
1026
1025
1014
1013
1012
1011
1010
1008
branch from Ash
1007
1006
1005
1004
1003
1002
1001
1009
999
998
997
996
995
994
993
992
991
990
989
988
987
986
985
984
983
982
981
980
979
978
977
968
967
brought here
966
965
964
963
962
961
960
brought here
959
958
957
956
955
946
A
H
E
C
L
Ash
Cd

ce
1154
1156
1153
1140
1138
1139
1141
1133
1142
1144
1143
1135
1134
1137
1136
1132
1131
Ph
1125
1126
1127
1128
1129
1130
Peach
1100
1099
1104
1101
1094
1093
1102
1098
1096
1103
1097
1092
1091
1084
1087
hole
1090
1081
1082
1085
1086
1089
1083
Ash
1088
1038
Ash
1037
1036
1034
1039
Ash
1035
1030
1031
1032
1033
1002
1004
1001
1000
1005
1003
Ash
997
995
998
996
999
A

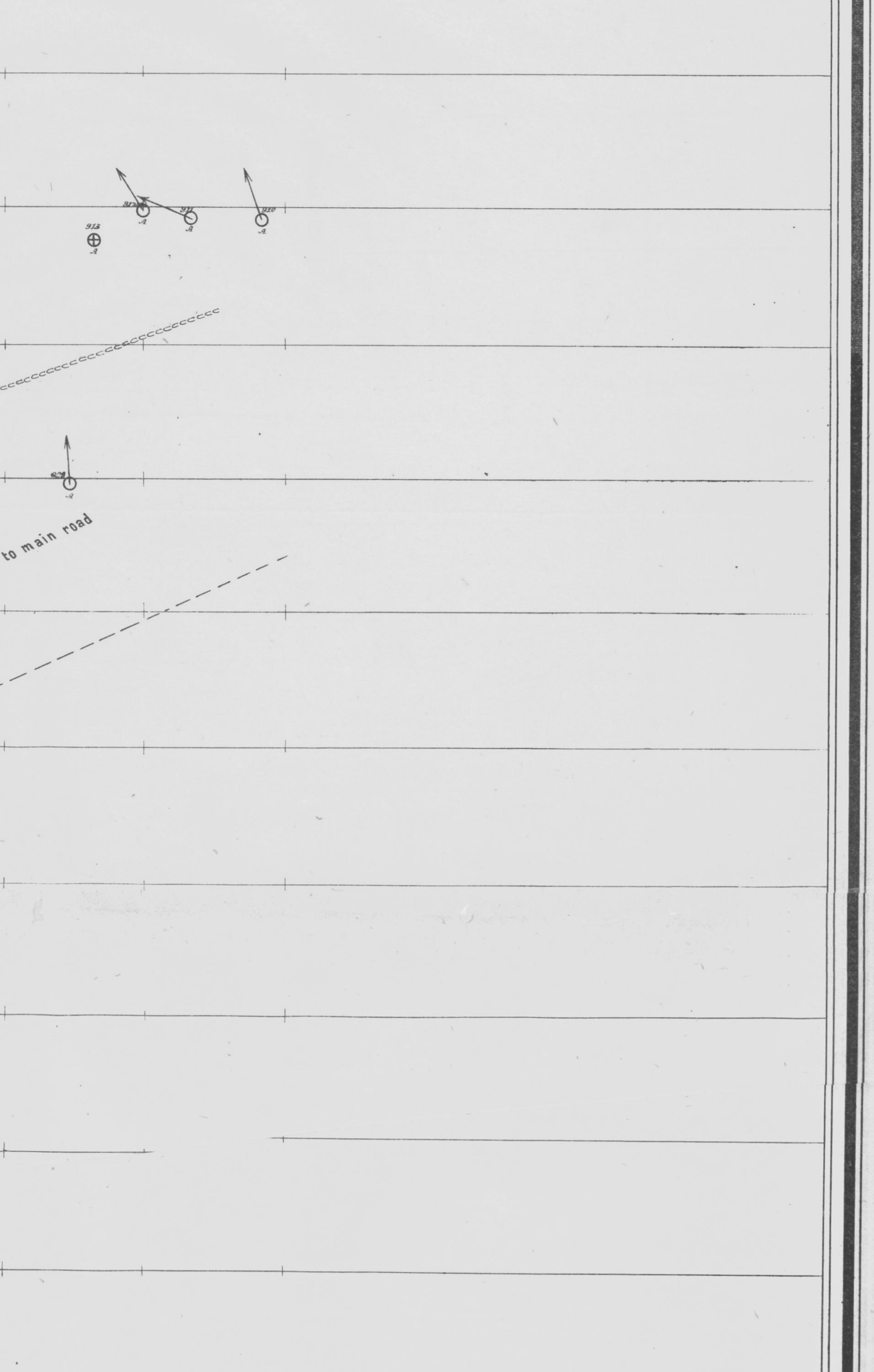

8500 feet
8000 feet
1½ miles
883
A
831
A
830
A
829
A
749
Ph
748
Ph
747
Ph
746
A
745

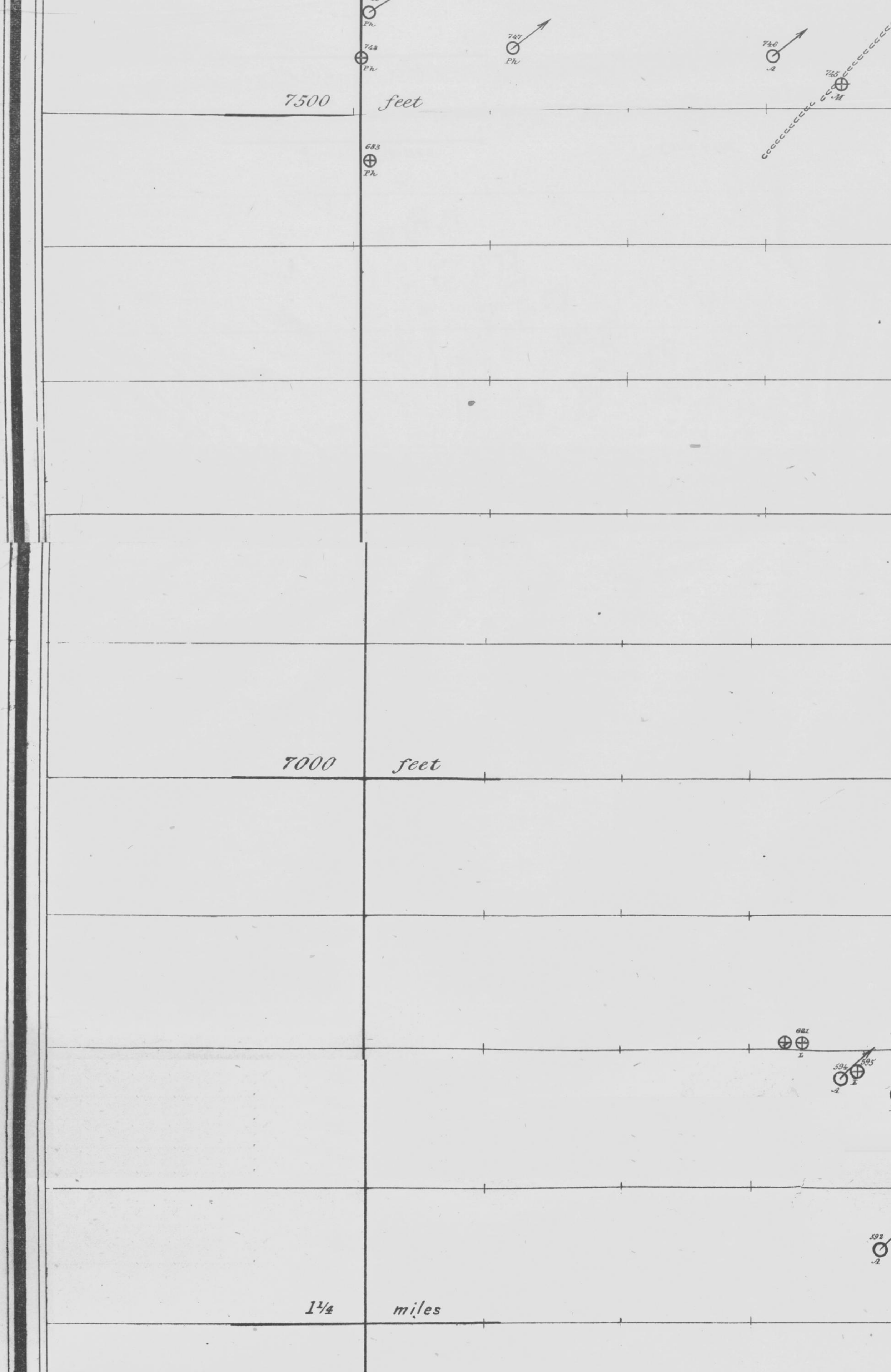

86
968
970
966
963
962
961
960
946
945
944
943
939
940
941
942
85
Open pasture
936
84
931
930
929
928
927
937
938
934
935
933
932
884
886
885
887
83
Frost's Farm
888
889
882
P
880
878
879
876
875
877
82
881
874
883
835
836
834
81
838
837
831
833
832
827
828
824
M.
821
S
823
H
822
820
brought here
80
830
829
826
Ash
825
819
777
Cedar
778
779
branch
780
brought here
Frost's
79
776
H
773
775
774
771
78
770
772
752
756
751
753
755
761
brought here
77
759
760
brought here
754
757
750
758
hole
744
742
738
733
732
740
730
727
brought here
746
741
737
734
76
729
728
726
745
735
A
L
H

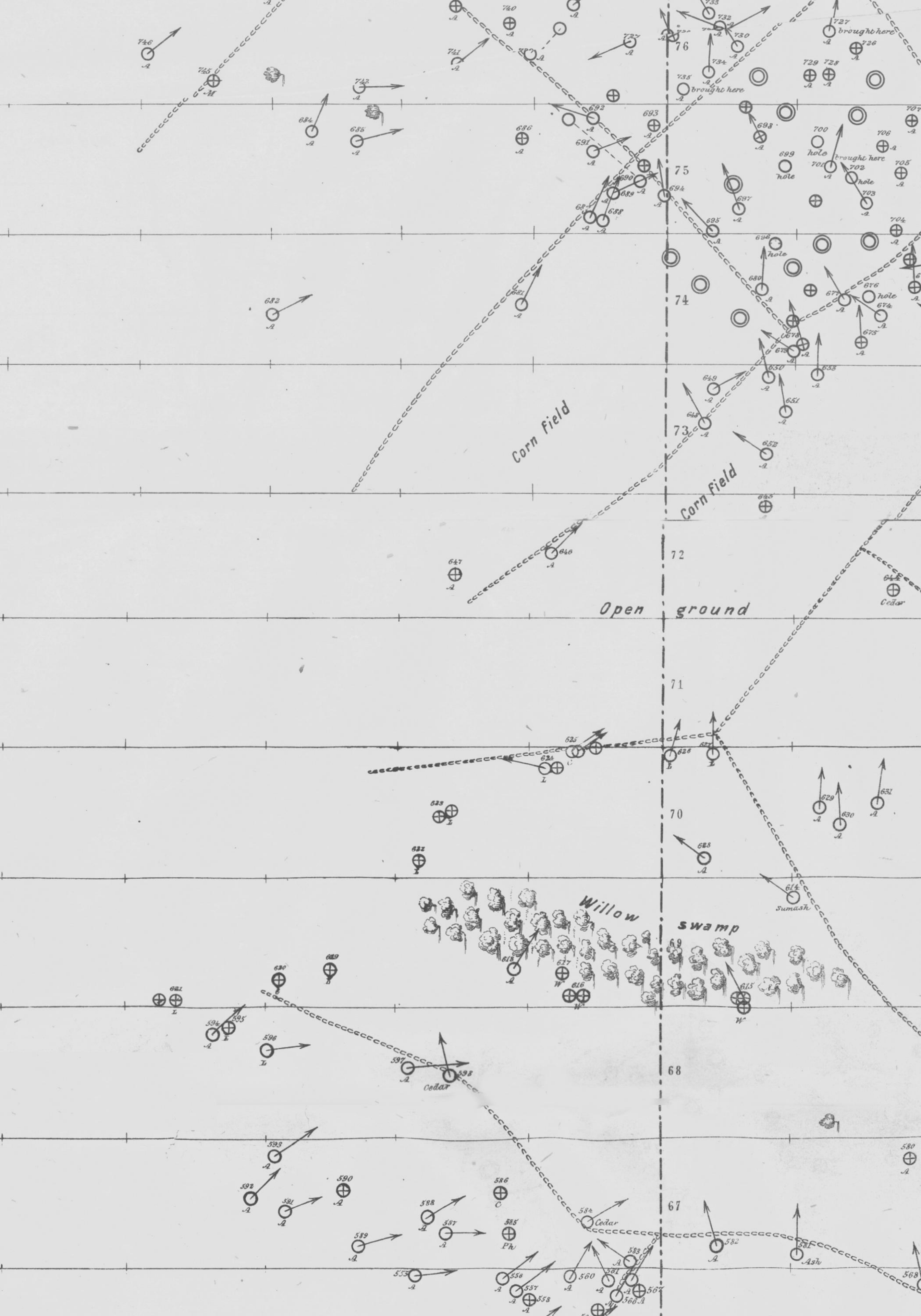

86
85
84
83
82
81
80
79
78
77
76
FROST'S
Cart way
Frost's cucumber patch
A row of young apple trees unhurt, ground low
Large Elms in this wood untouched
Large forest trees
Wm Hill's or
Frost's Pasture
Southerly side of these trees and wall covered with mud
Orchard
960 brought here
840 brought here
820 brought here
780 brought here
779 branch
762 brought here
761 brought here
760 brought here
727 brought here
758 hole
922 H scorched
923 H scorched
894 Ash
929 Ash
968
966
963
962
961
946
945
944
943
942
941
940
948
947
951
953
952
950
949
921
920
919
918
936
934
935
933
932
931
930
928
927
926
925
924
891
893
892
917
916
915
914
886
885
887
888
889
890
880
873
877
879
875
876
881
874
873
839
836
838
837
821
824
823
822
819
818
896
898
897
895
899
900
903
904
905
906
902
901
871
870
872
868
869
867
866
863
865
864
862
861
860
848
849
847
846
850
852
851
845
844
843
842
841
814
816
815
817
805
804
806
808
807
803
802
813
812
811
810
809
800
801
799
792
798
797
796
795
794
793
791
790
789
786
785
784
767
766
769
768
765
764
763
770
759
733
732
730
734
724
725
726
727
728
729
722
735

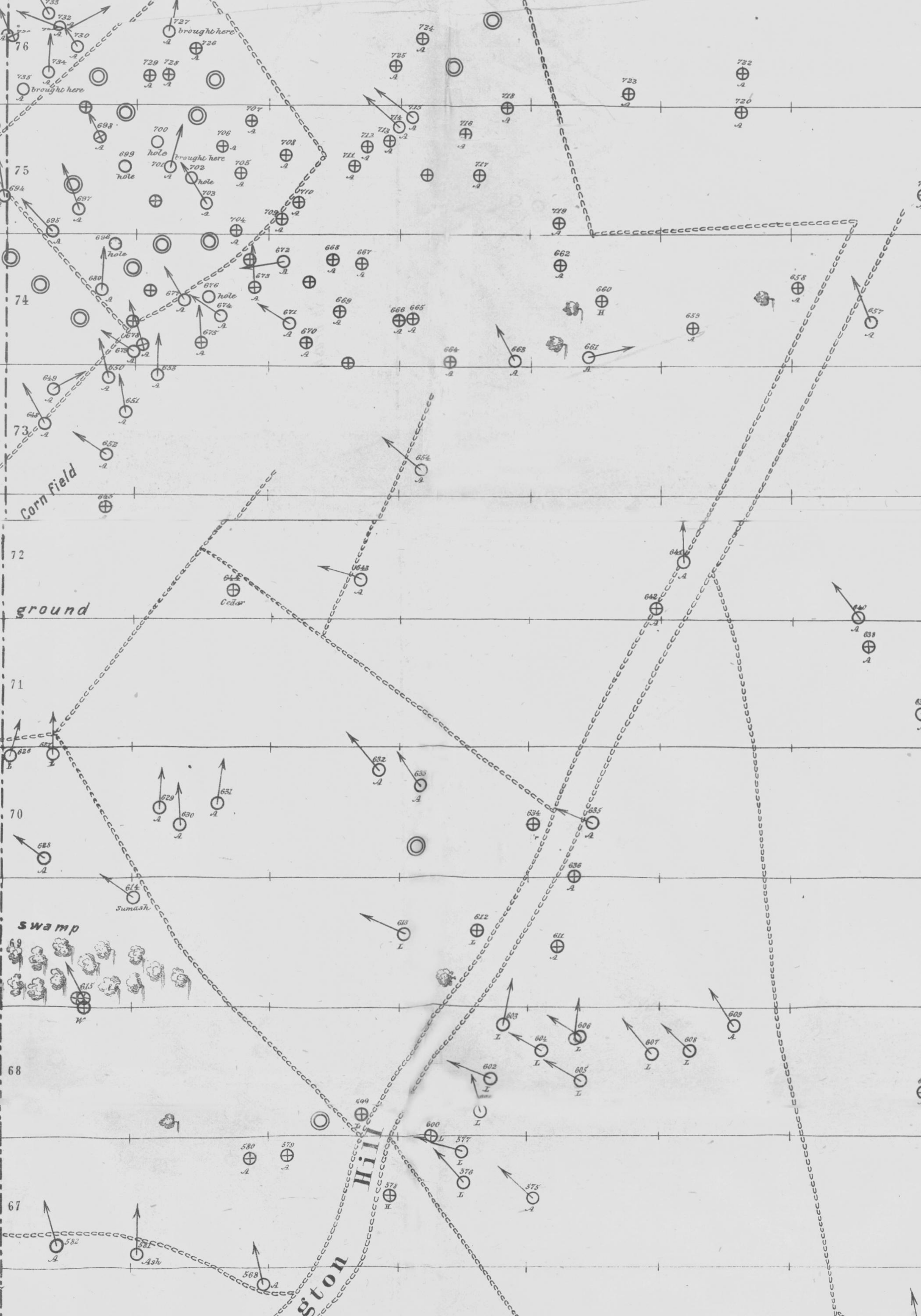


ung apple trees unhurt, ground low
Wm Hill's orchard
Slope of the hill to main road
se trees and wall covered with mud
953
952
954
913
907
908
906
905
904
903
900
899
898
897
902
901
858
857
856
863
860
862
861
865
864
859
848
849
853
854
847
850
852
851
845
844
805
804
808
806
803
802
807
809
810
800
801
799
764
722
A
L


912
911
910
913
A
A
A
A
A
to main road


Ph
748
Ph
747
Ph
746
A
745
M
7500
feet
683
Ph
7000
feet
621
L
594
A
595
L
592
A
1¼
miles


746
745
742
740
741
737
739
733
732
731
730
727
brought here
726
729
728
734
735
brought here
76
684
685
686
692
693
698
700
hole
brought here
706
707
705
691
701
702
hole
699
hole
75
690
689
694
697
703
687
688
695
704
696
hole
682
681
680
677
676
hole
674
74
675
678
679
650
653
649
651
648
73
652
Corn field
Corn field
645
646
72
647
644
Cedar
Open ground
71
625
624
626
627
629
630
631
623
70
622
628
614
Sumash
Willow swamp
69
618
617
616
615
620
619
621
594
595
596
597
598
Cedar
68
593
590
586
592
591
588
587
585
Ph
589
584
Cedar
67
583
582
581
Ash
580
555
556
557
558
560
561
562
563
567
568
A
M
L
C
W


76
75
74
73
72
71
70
69
68
67
brought here
brought here
brought here
hole
hole
hole
hole
hole
Corn Field
ground
swamp
Cedar
Sumash
Ash
W
Hill
gton
735
734
733
732
730
729
728
727
726
725
724
723
722
720
718
717
716
715
714
713
712
711
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706
705
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703
702
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697
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665
664
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652
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643
642
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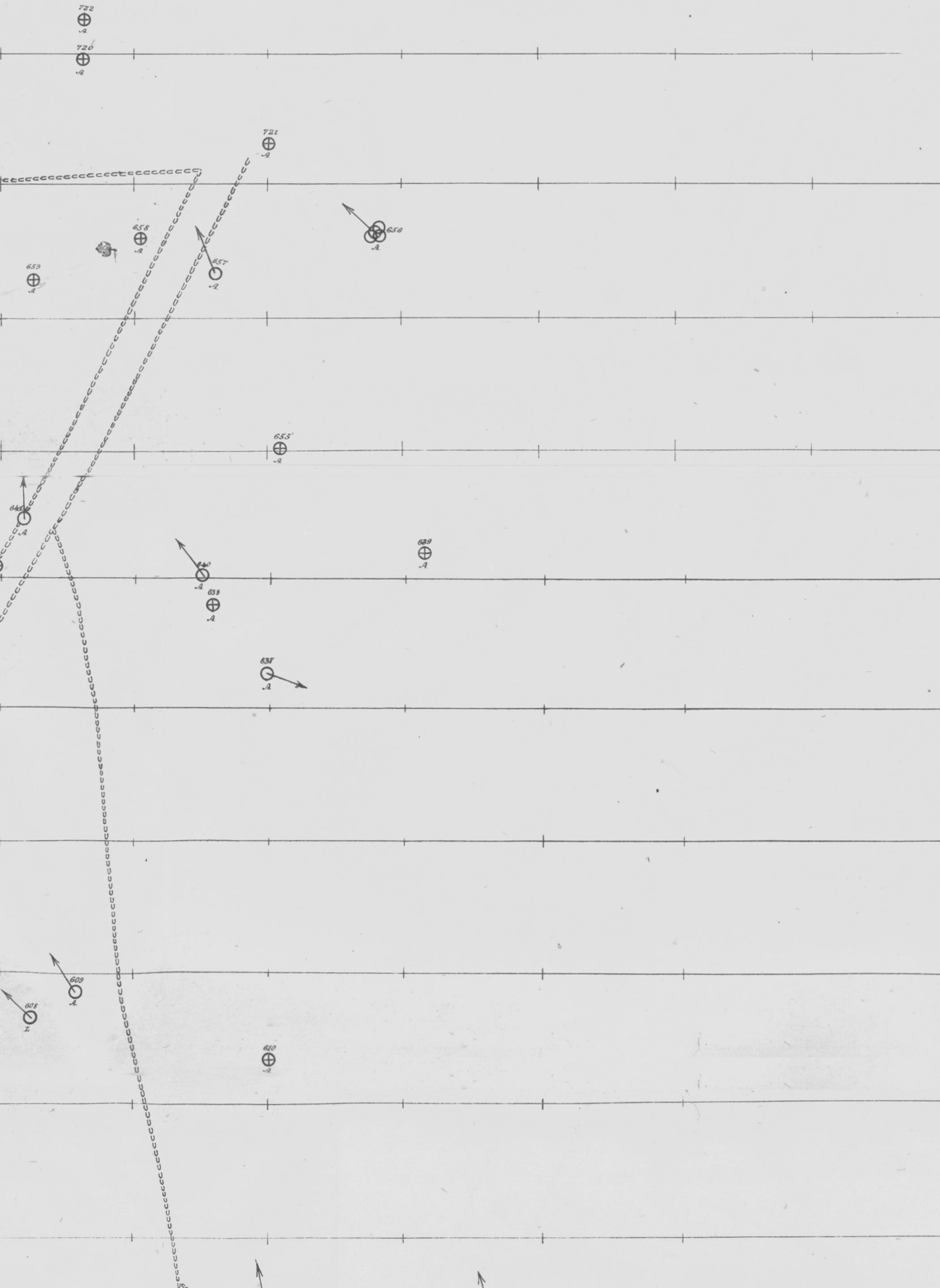
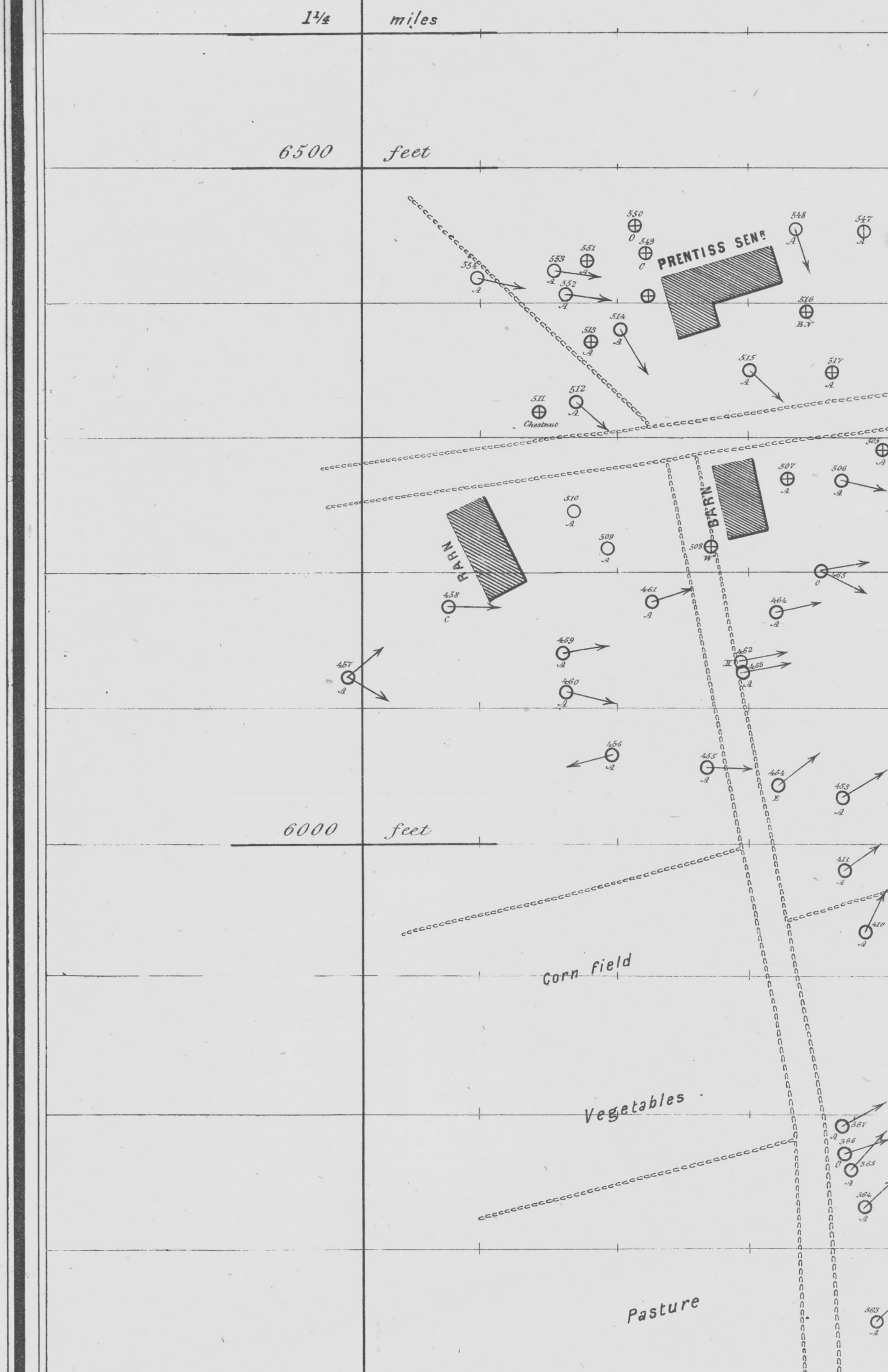
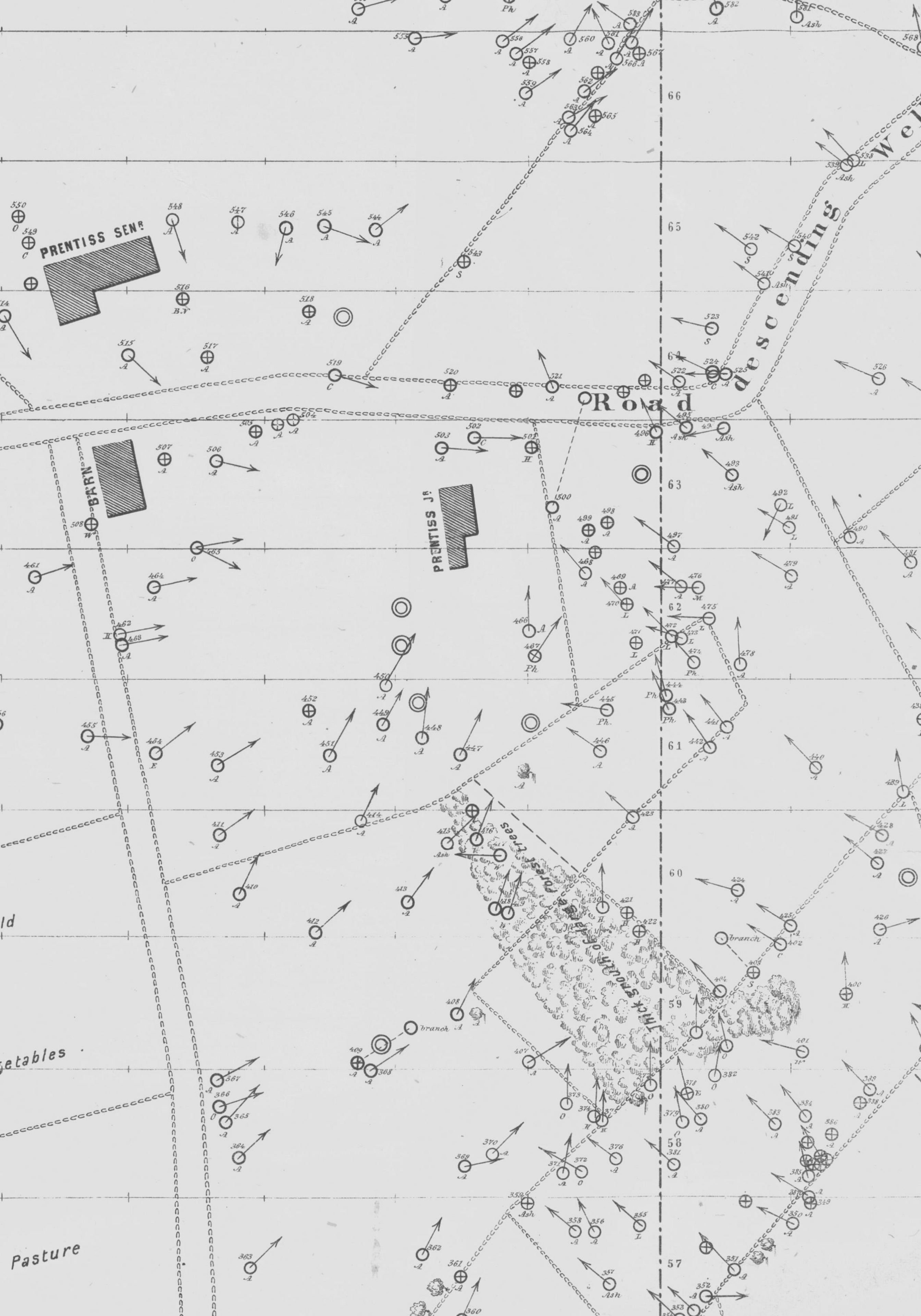
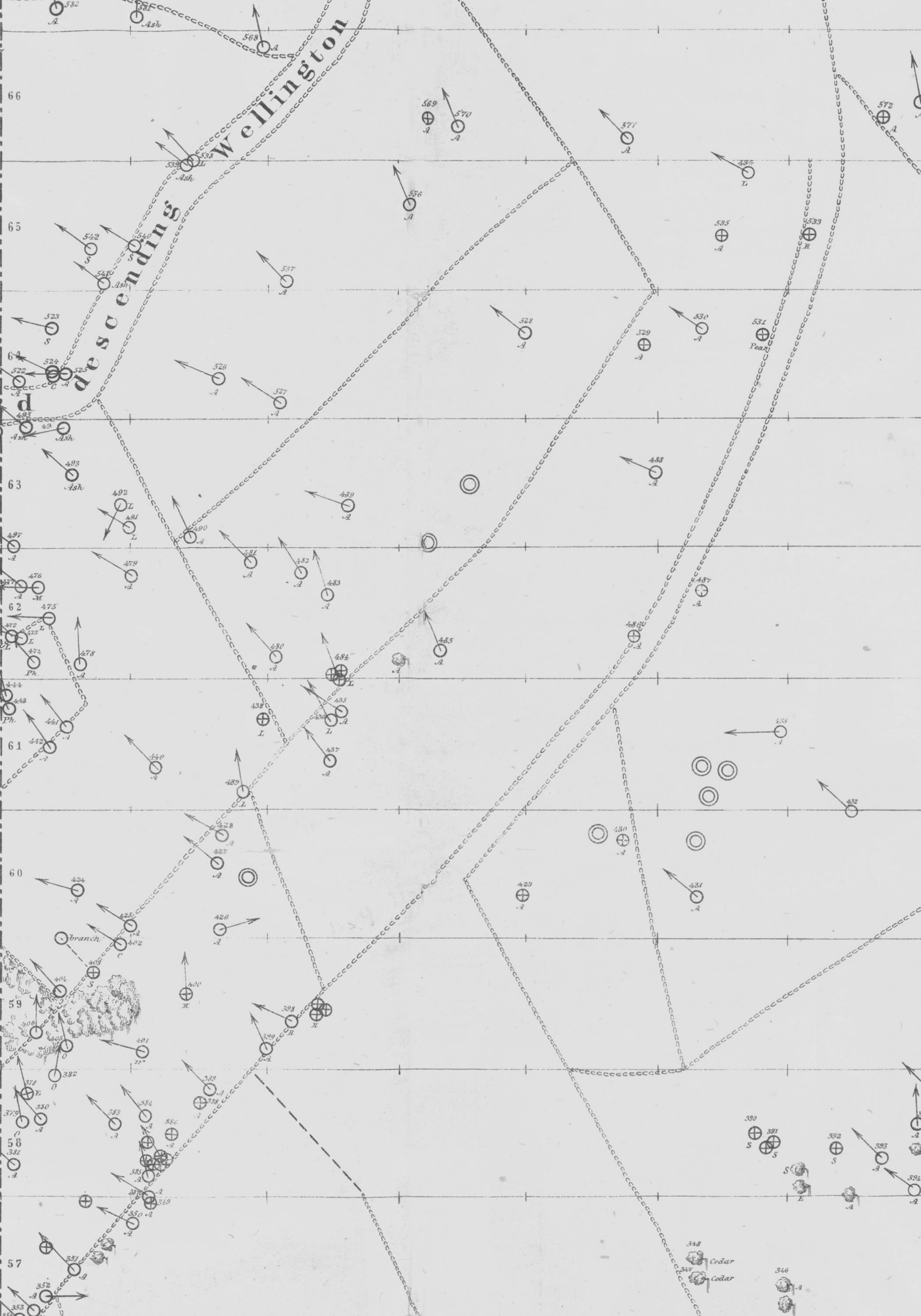
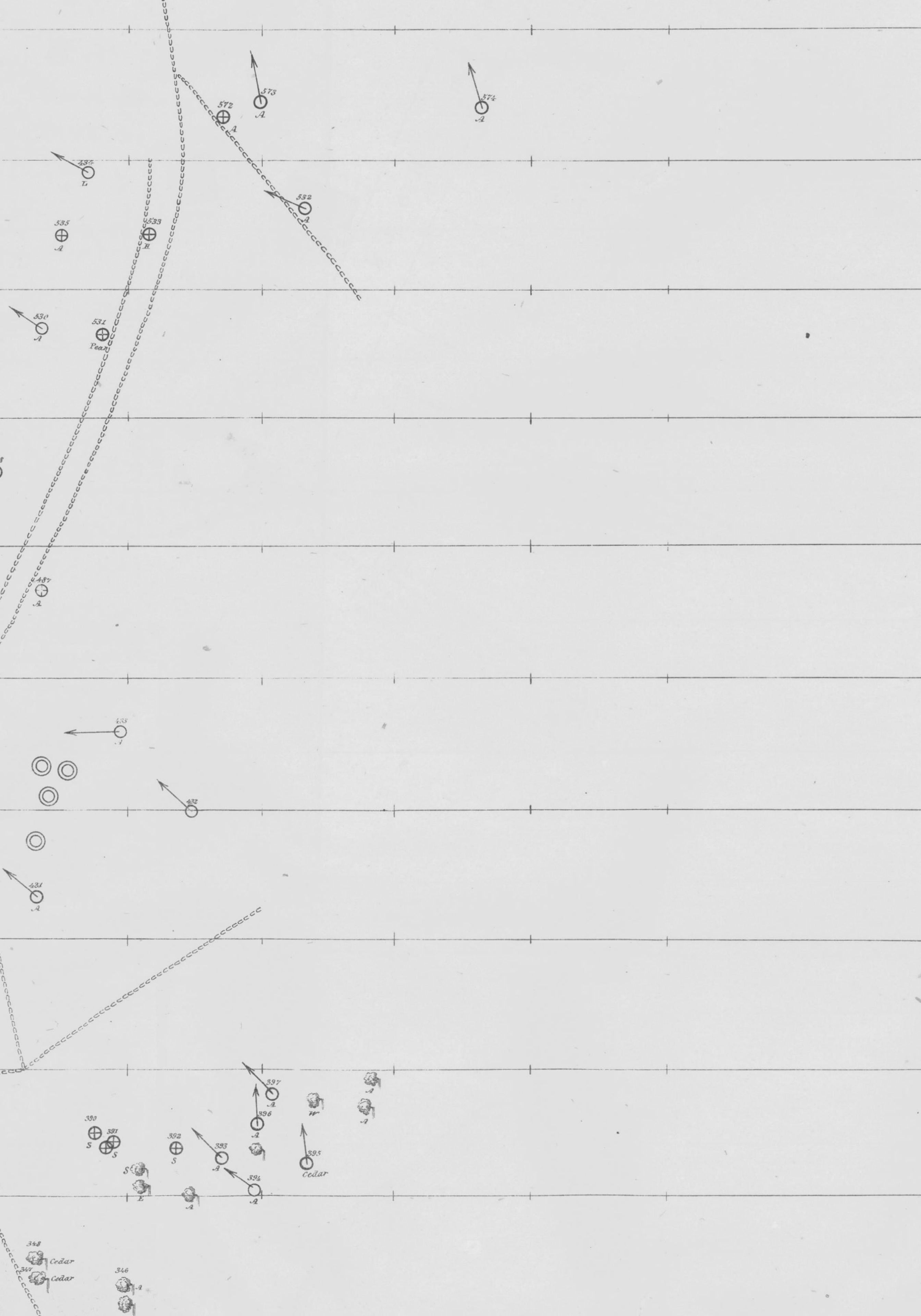
640
638
635
634
633
632
631
630
629
628
626
614
615
613
612
611
609
608
607
606
605
604
603
602
600
599
582
581
580
579
578
577
576
575
568

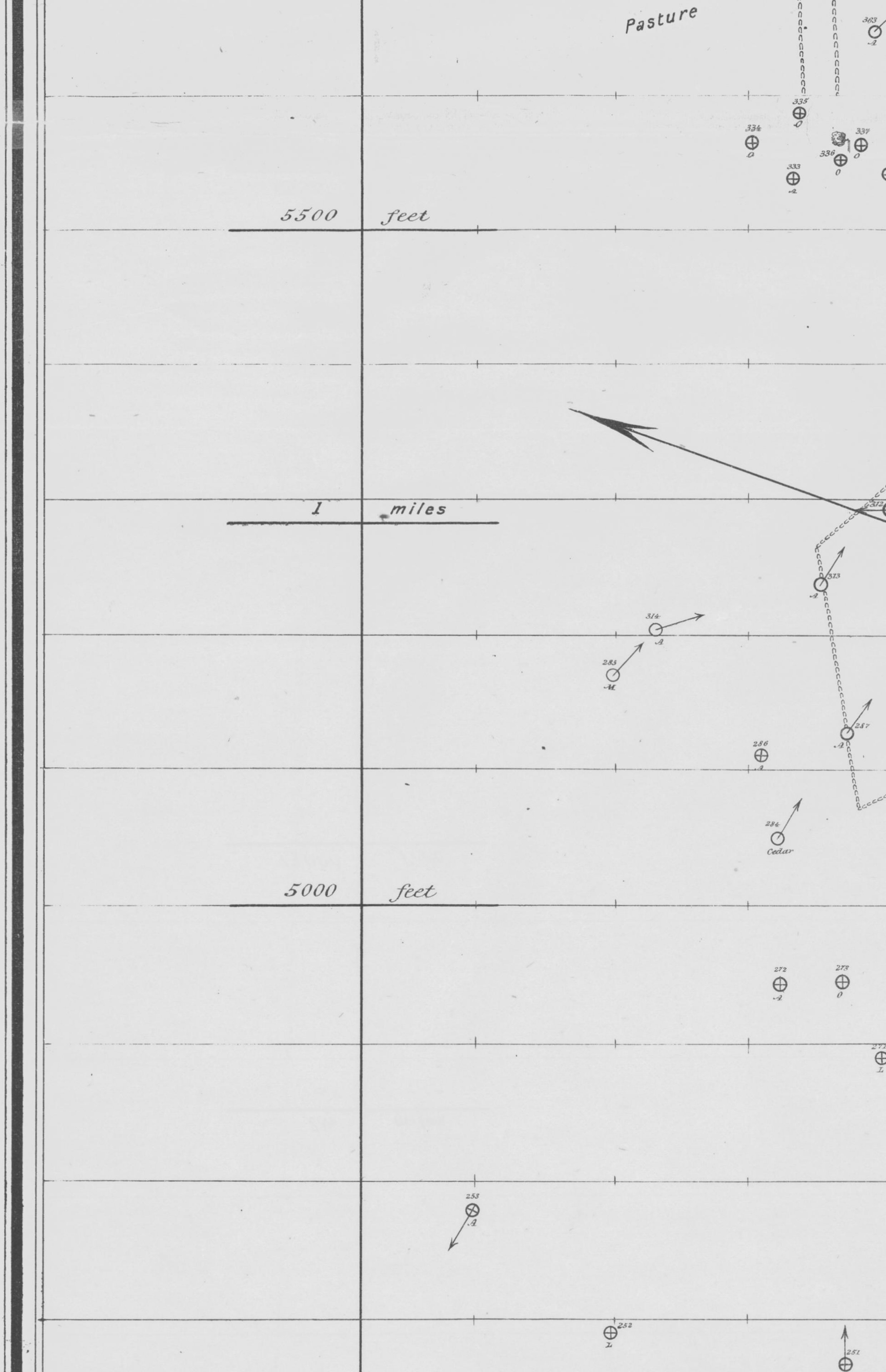

722
A
720
A
721
A
658
A
659
A
657
A
656
A
655'
A
641
A
640
A
638
A
639
A
637
A
609
A
608
L
610
A

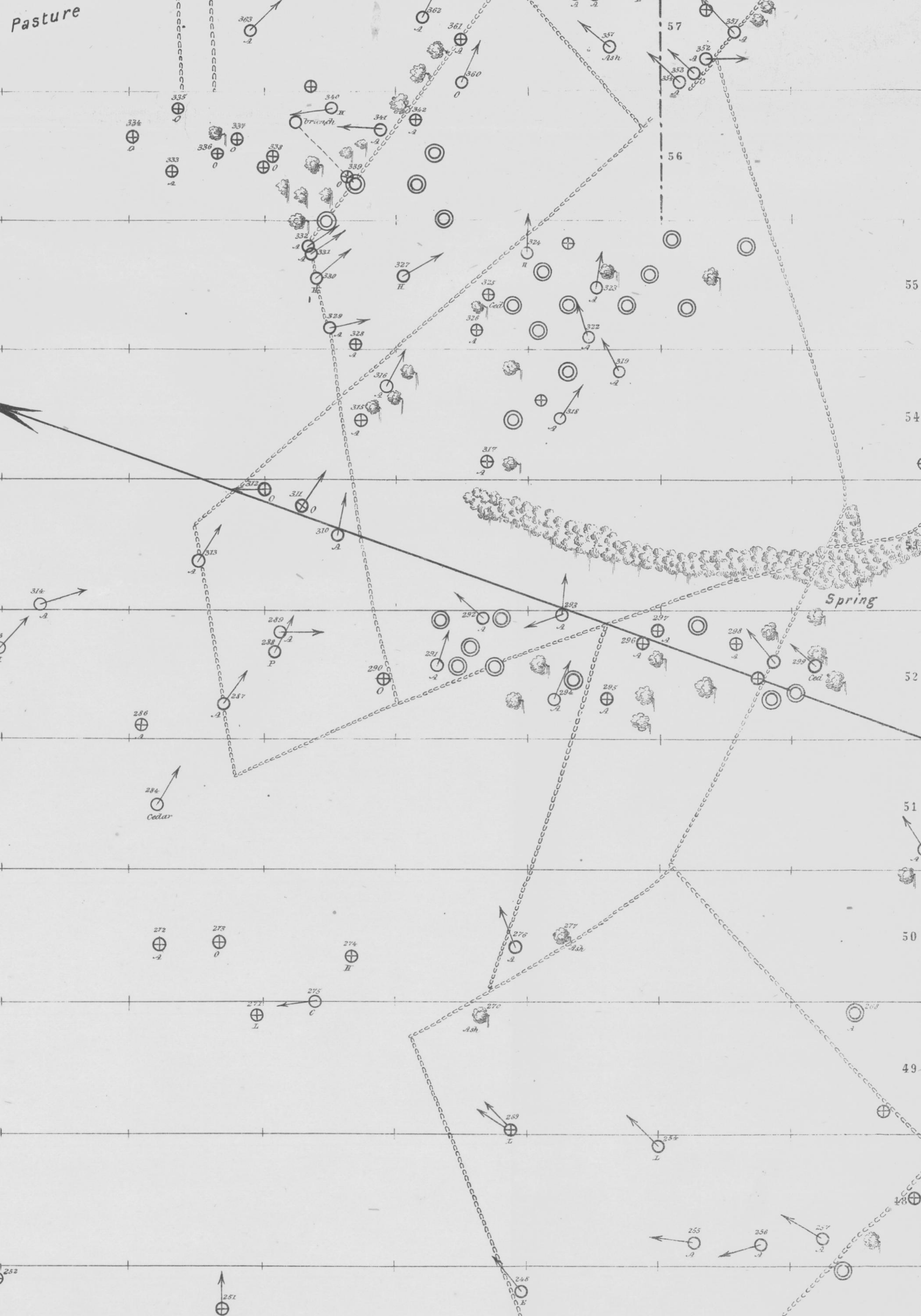

1¼ miles
6500 feet
PRENTISS SENR
BARN
BARN
Chestnut
6000 feet
Corn field
Vegetables
Pasture
550
549
551
553
554
552
548
547
516
514
513
515
517
511
512
505
507
506
510
509
508
465
461
458
464
459
462
463
457
460
456
455
454
453
411
410
367
366
365
364
363

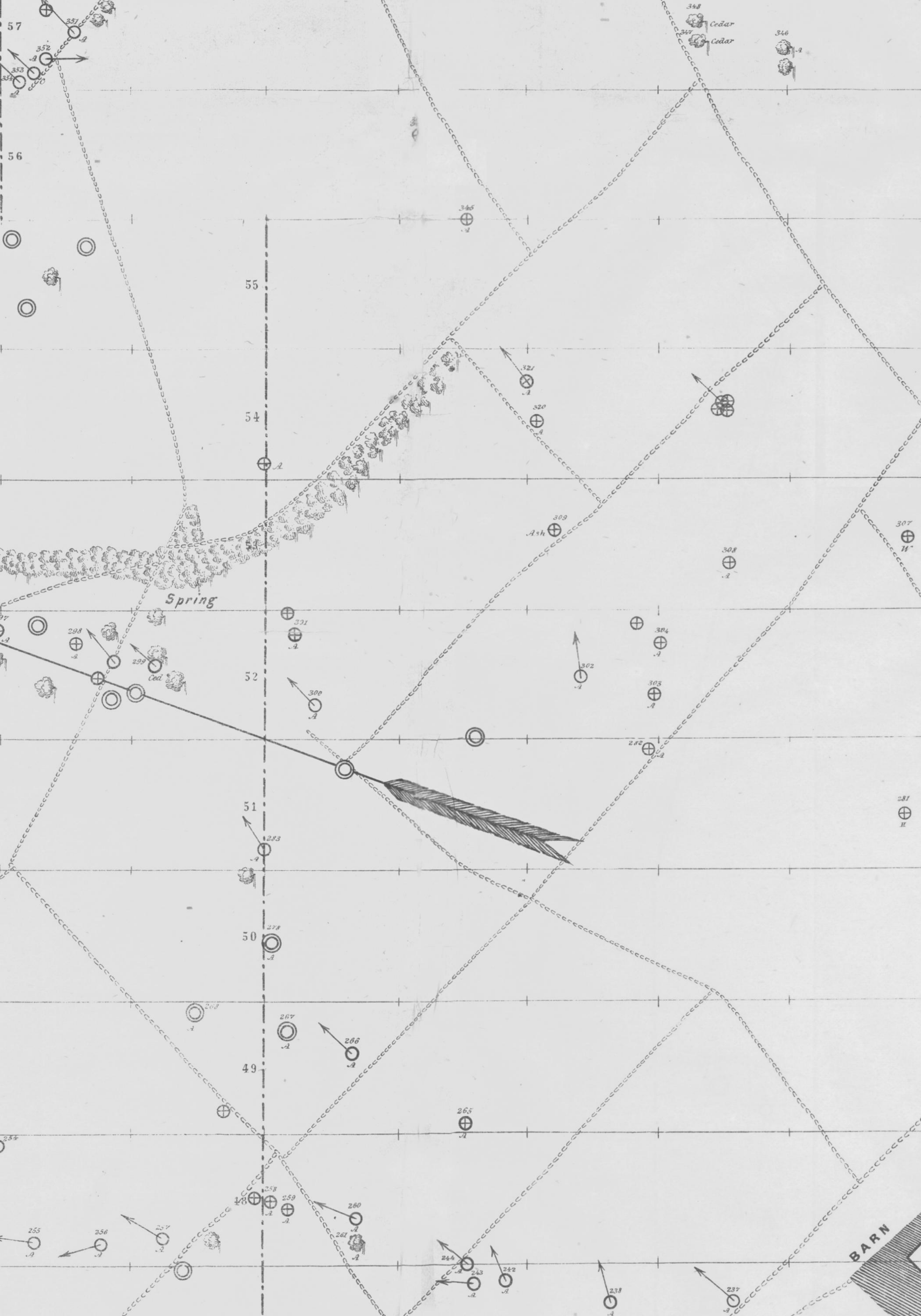

PRENTISS SENR
PRENTISS JR
BARN
Road descending Wel
Thick growth of deciduous forest trees
Pasture
etables
ld
branch
66
65
64
63
62
61
60
59
58
57


descending Wellington
d
66
65
64
63
62
61
60
59
58
57
branch
Cedar
Cedar
Pear
Ash
568
569
570
571
572
536
535
533
542
540
541
537
538
539
523
524
525
522
526
527
528
529
530
531
488
489
490
491
492
493
495
497
476
475
479
481
482
483
487
480
484
485
486
478
438
435
436
437
433
440
441
442
439
428
427
424
425
426
402
403
404
405
406
400
401
398
399
432
430
431
429
382
378
379
380
381
383
384
385
386
388
389
390
391
392
393
394
348
347
346
349
350
351
352
353

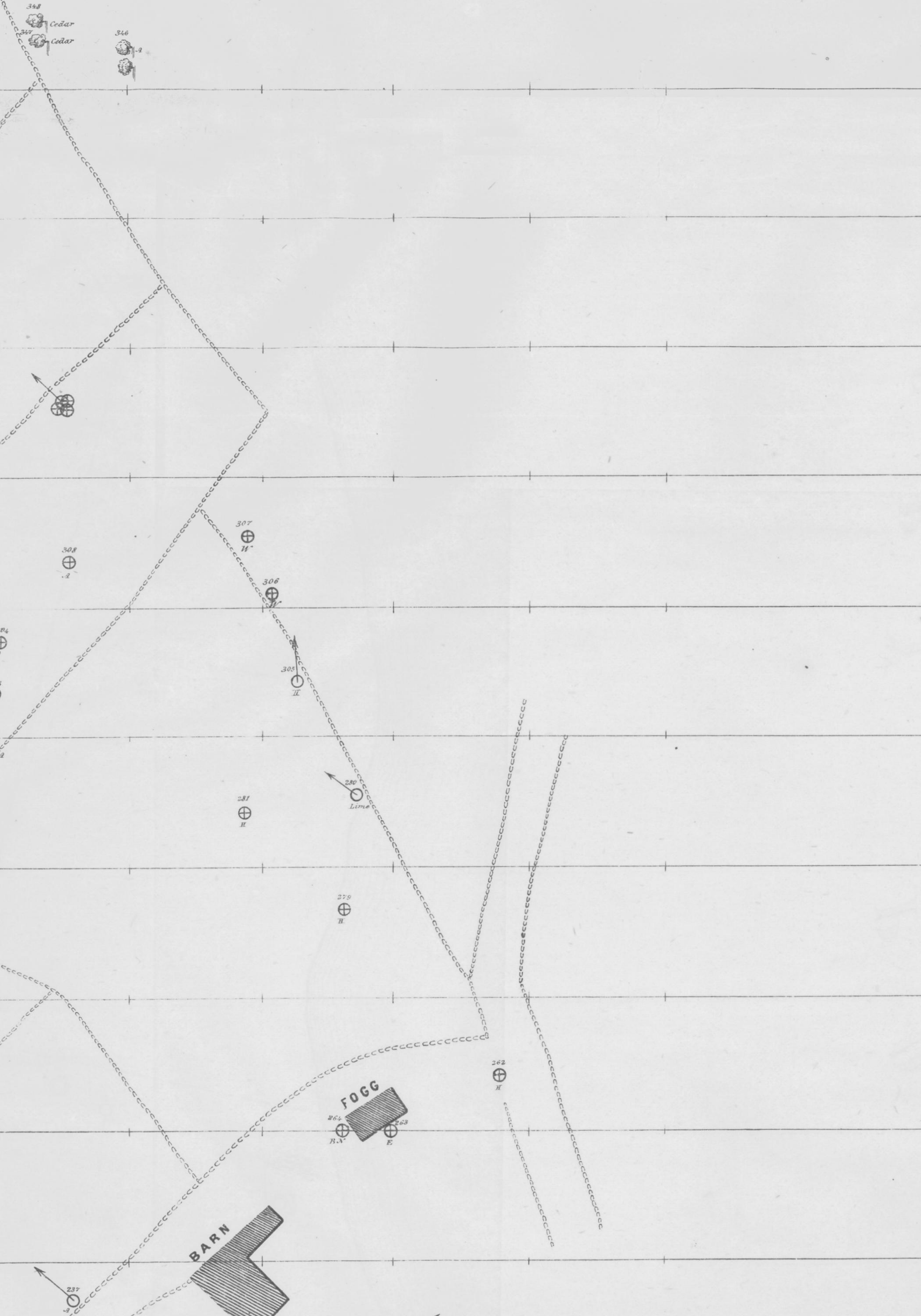

572
A
573
A
574
A
434
L
535
A
533
B
532
A
530
A
531
Pear
487
A
433
A
432
431
A
397
A
396
A
W
A
A
390
S
391
S
392
S
393
A
395
Cedar
394
A
S
E
A
348
Cedar
347
Cedar
346
A

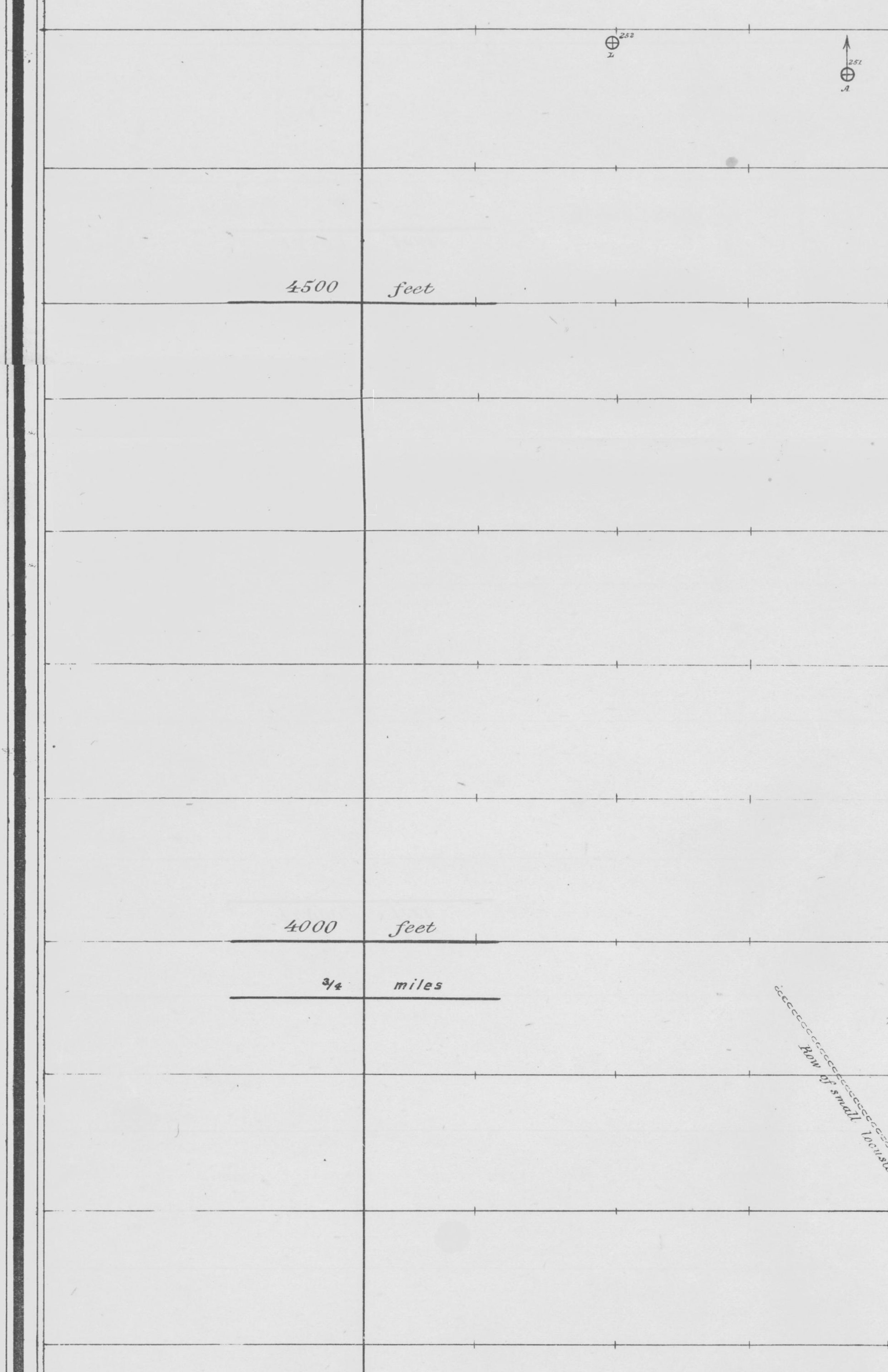

Pasture
363
A
335
O
334
O
337
336
O
O
333
A
5500 feet
312
1 miles
313
A
314
A
283
M
287
A
286
A
284
Cedar
5000 feet
272
A
273
O
L
253
A
252
L
251


Pasture
57
56
55
54
52
51
50
49
48
Spring
363 A
362 A
361 A
360 O
357 Ash
351 A
352 A
353 O
354 A
335 O
334 O
337 O
336 O
333 A
338 O
340 H
branch
341 A
342 A
339 O
332 A
331 A
330 H
327 H
324 H
323 A
325 Ced
326 A
329 A
328 A
322 A
319 A
316 A
315 A
318 A
317 A
312 O
311 O
310 A
313 A
314 A
289 A
288 P
287 A
286 A
284 Cedar
290 O
291 A
292 A
293 A
294 A
295 A
296 A
297 A
298 A
299 Ced
276 A
277 Ash
272 A
273 O
274 H
275 C
271 L
270 Ash
268 A
263 L
254 L
255 A
256 A
257 A
252
251
248 E

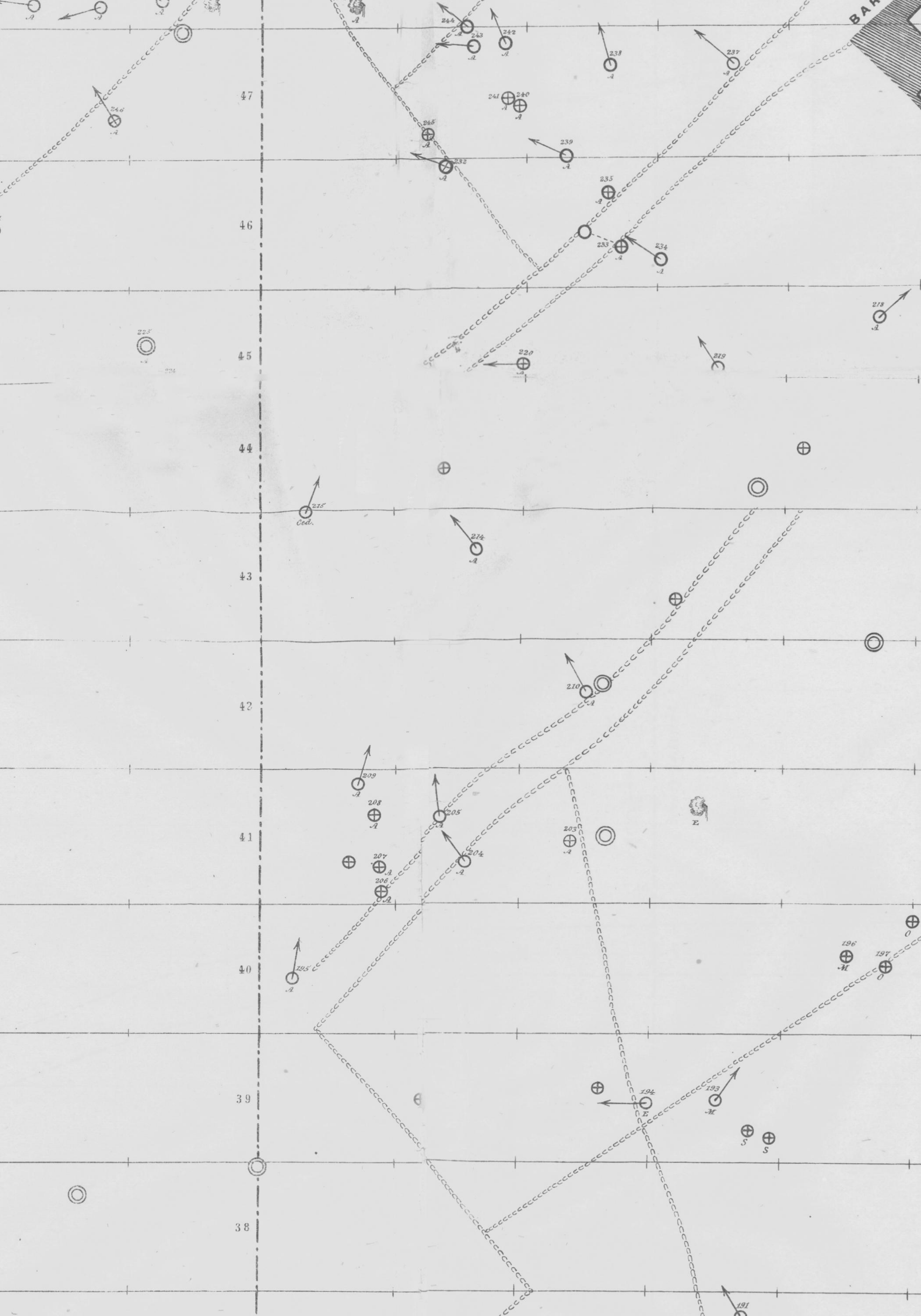


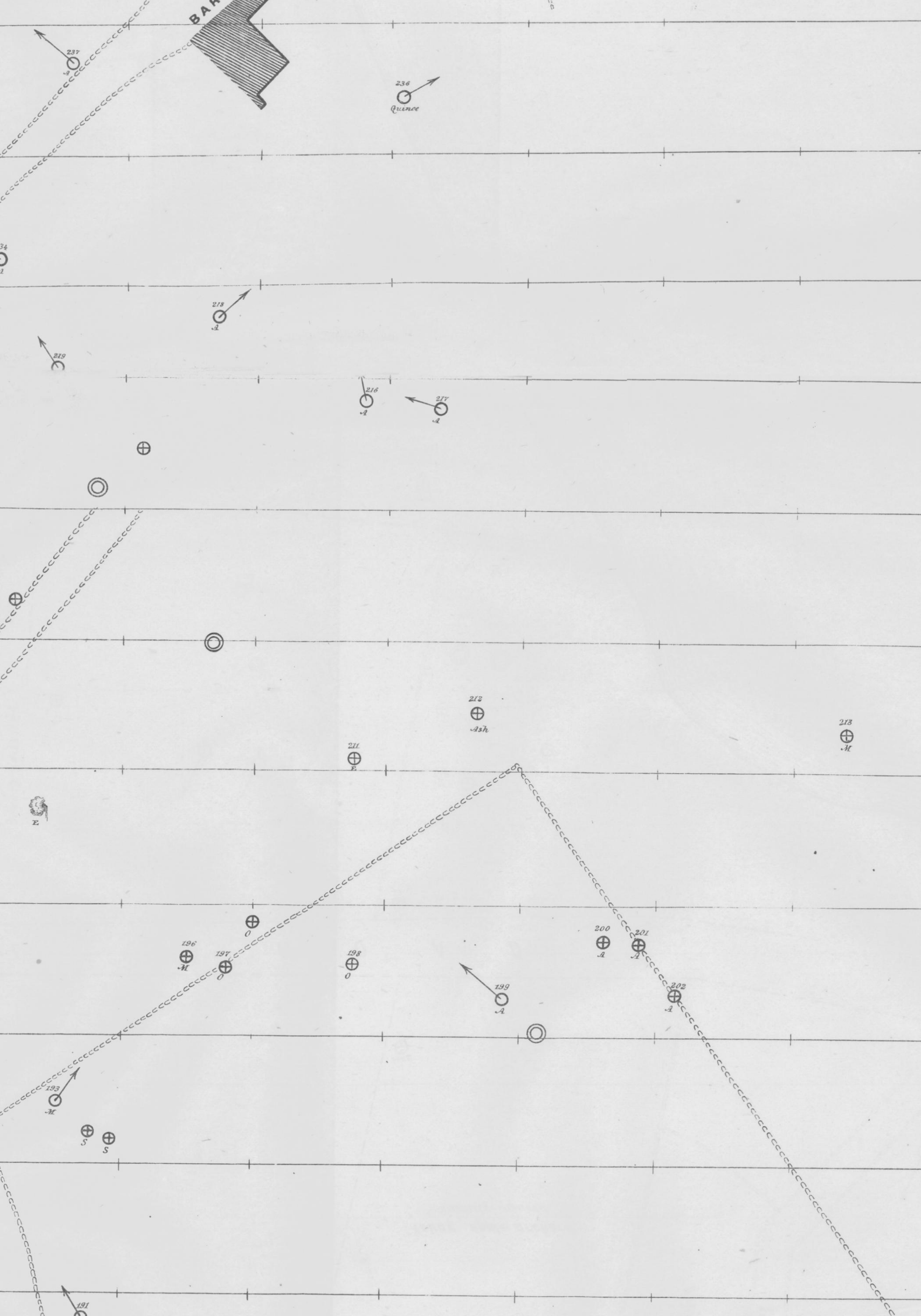
57
351
352
353
354
56
348 Cedar
347 Cedar
346
345
55
321
320
54
309 Ash
308
307
Spring
301
304
298
299 Ced.
302
303
52
300
282
51
281
283
50
278
268
267
266
49
265
254
48
258
259
260
261
255
256
257
244
243
242
238
237
BARN


348
Cedar
347
Cedar
346
A
307
W
308
A
306
W
305
H
280
Lime
281
H
279
H
262
H
FOGG
264
B.W.
263
E
BARN
237
A

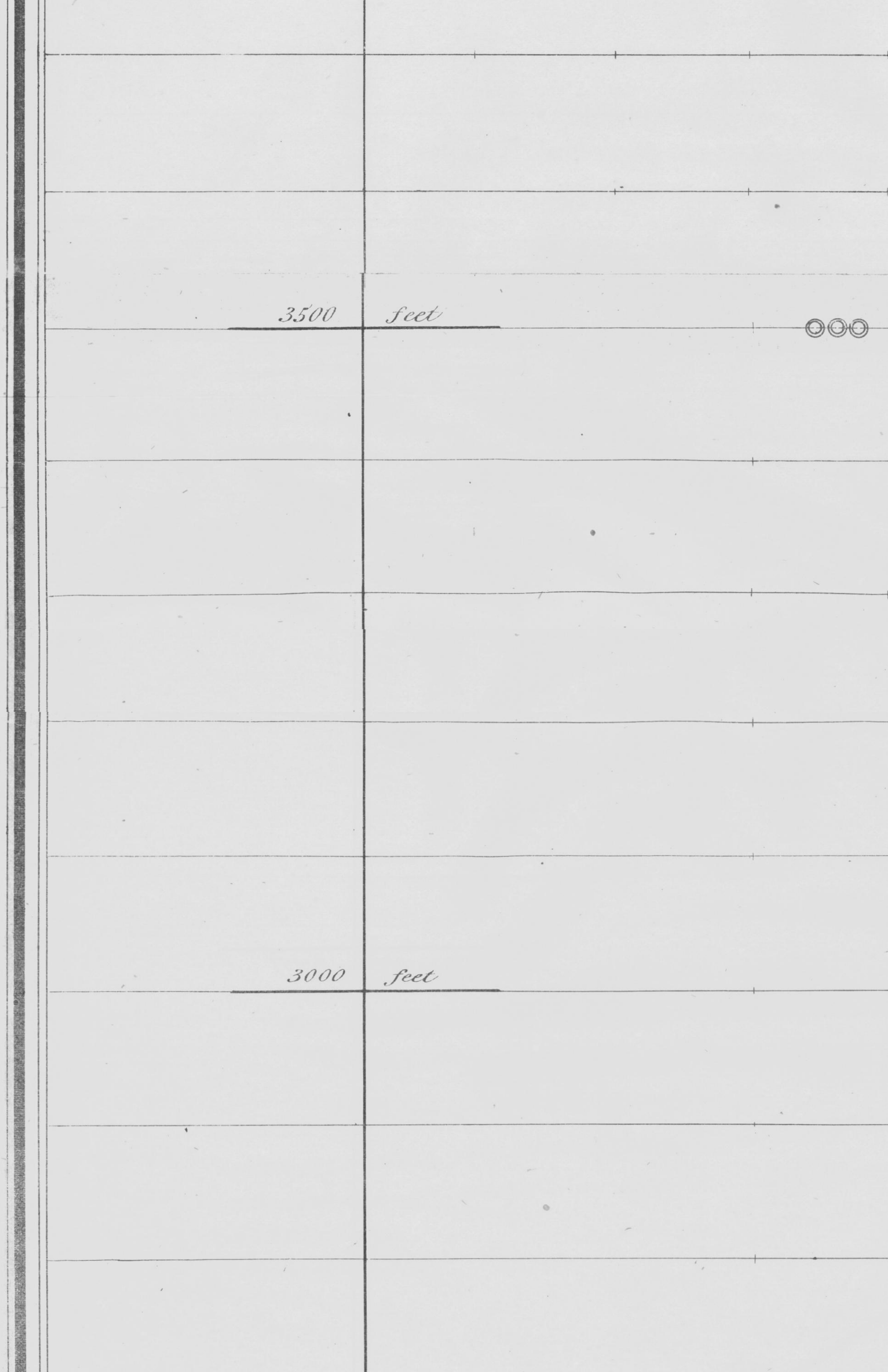

252
L
251
A
4500 feet
4000 feet
3/4 miles
Row of small locust

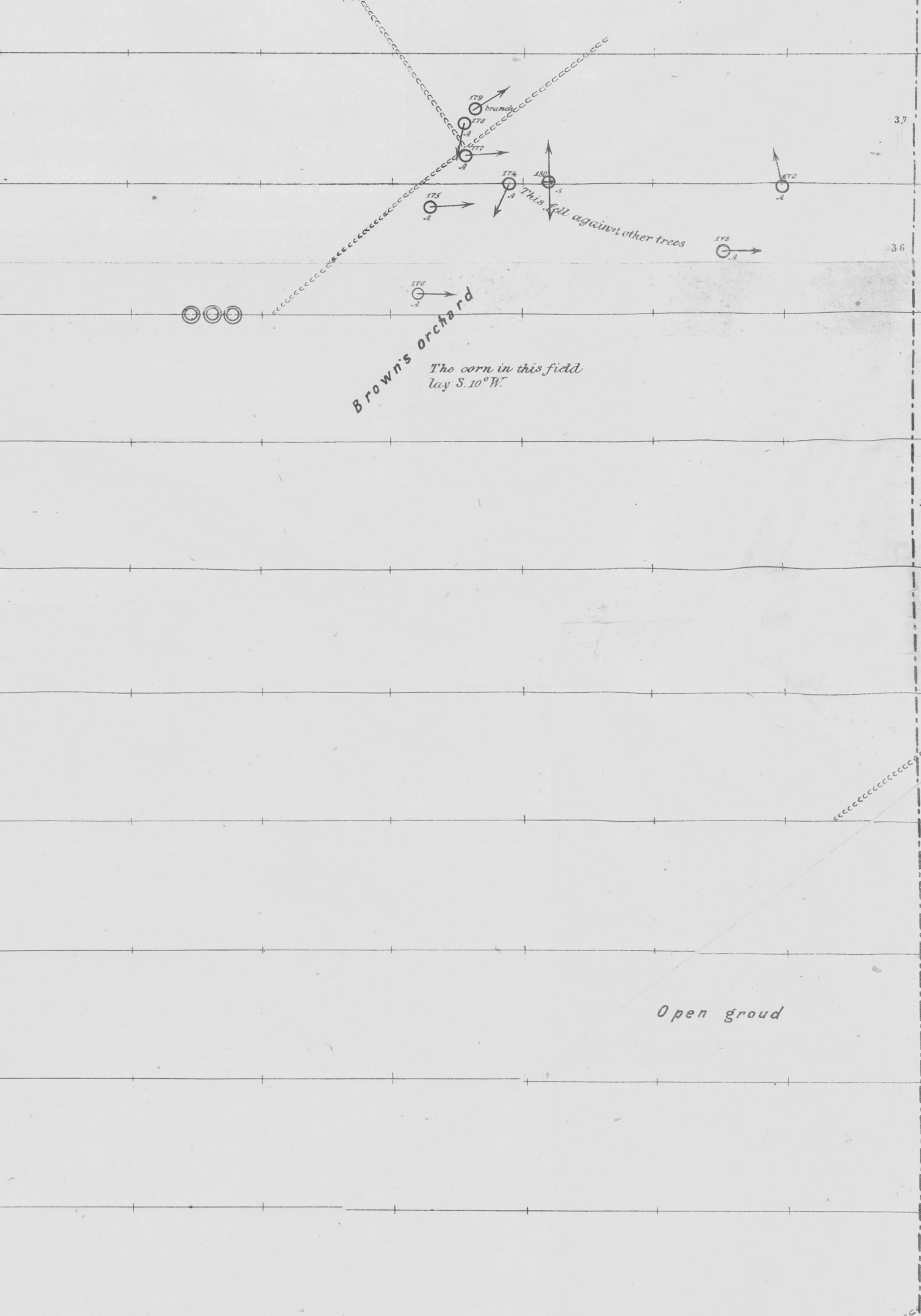
252
251
A
249
Peach
250
Peach
248
E
247
A
246
A
A
A
228
A
229
H
231
A
230
A
226
A
227
A
225
224
47
46
45
44
43
42
41
40
39
38
Row of small locusts broken S. to S. 40° W.

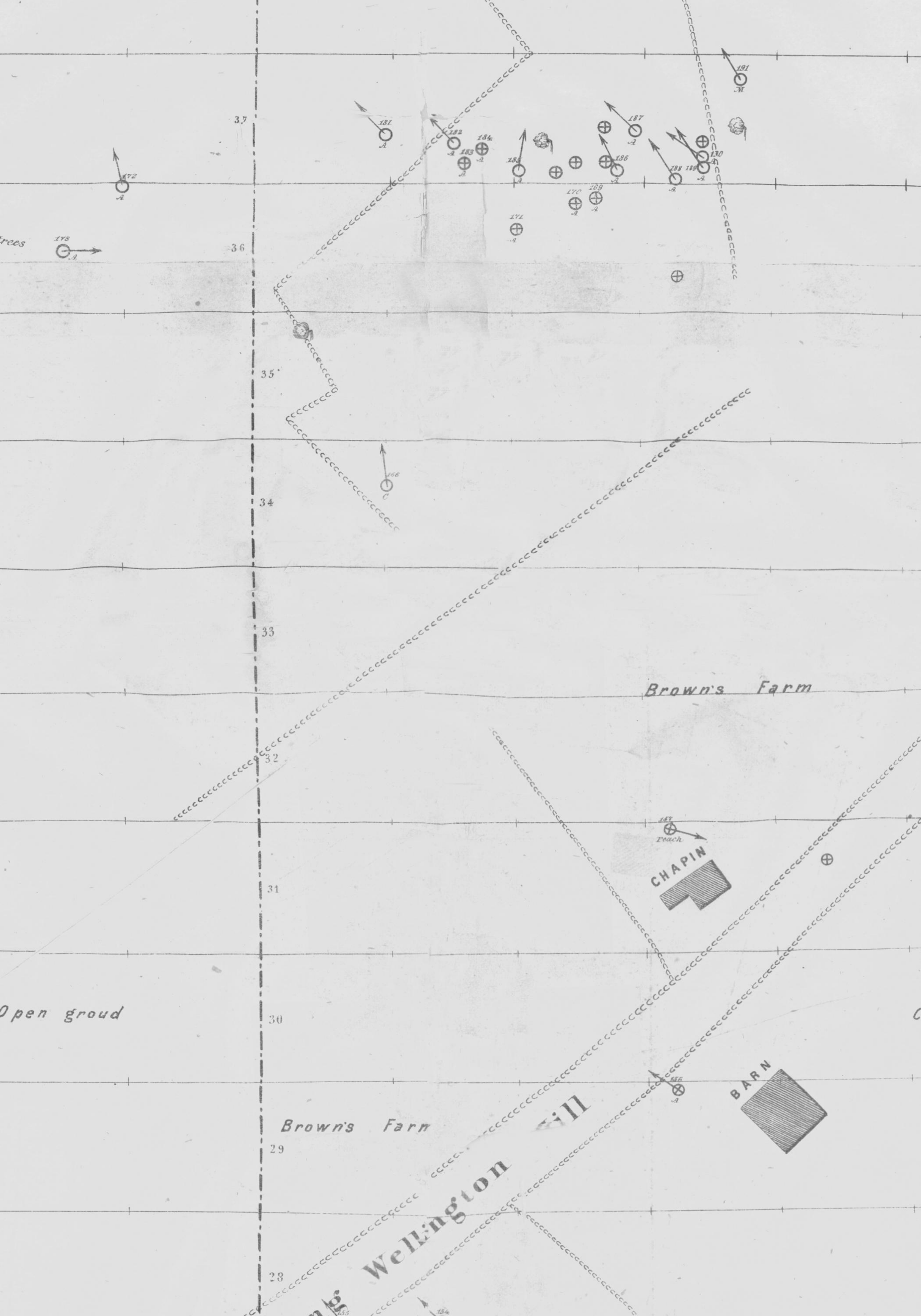

BA
47
46
45
44
43
42
41
40
39
38
244
243
242
238
237
241
240
246
245
239
232
235
233
234
225
224
220
219
218
215
Ced.
214
210
209
208
207
206
205
204
203
E
196
M
197
O
O
195
194
E
193
M
S
S
191

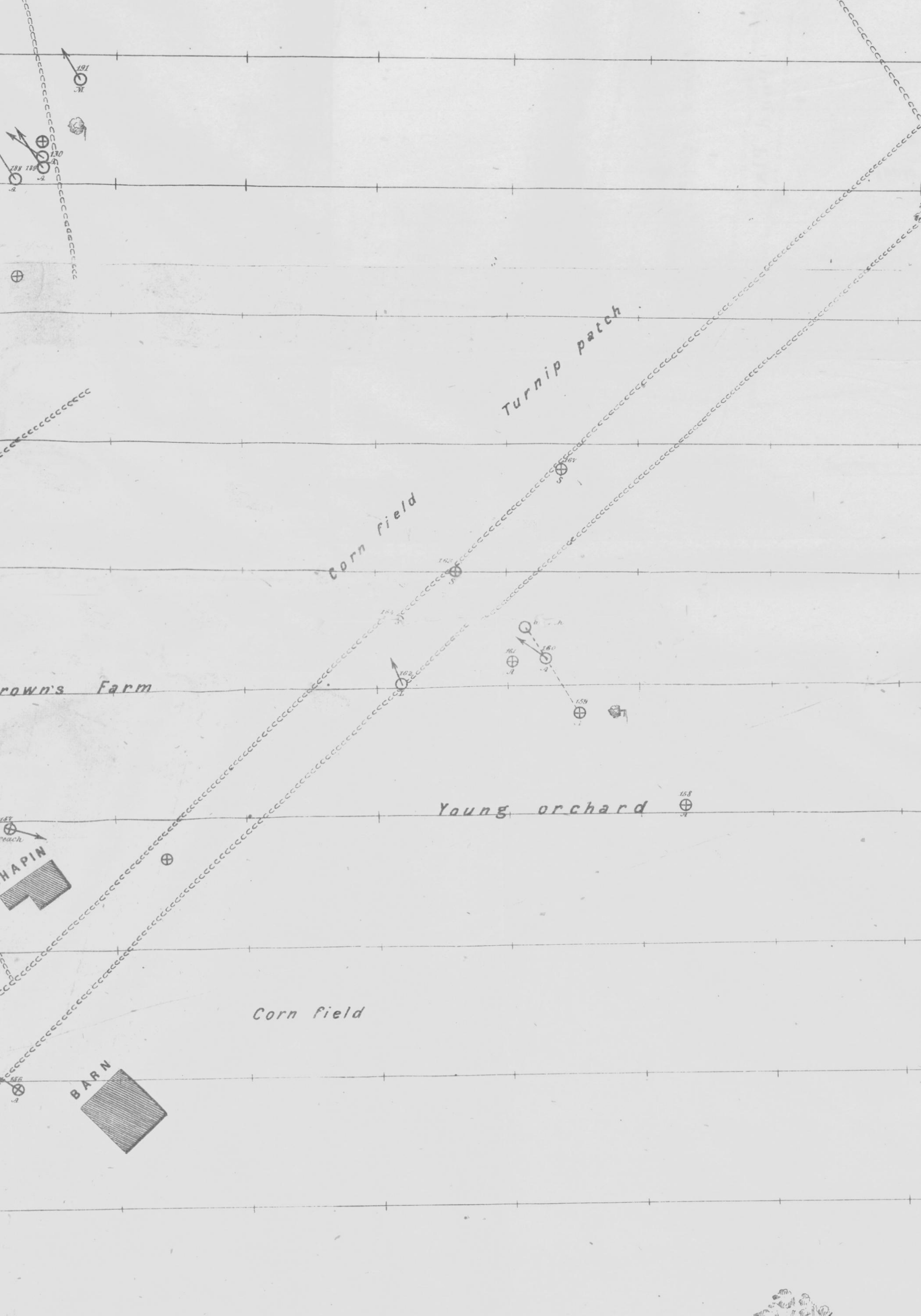

BAR
237
A
236
Quince
34
218
A
219
216
A
217
A
212
Ash
211
E
213
M
E
O
196
M
197
O
198
O
199
A
200
A
201
A
202
A
193
M
S
S
191

213
M
202
A

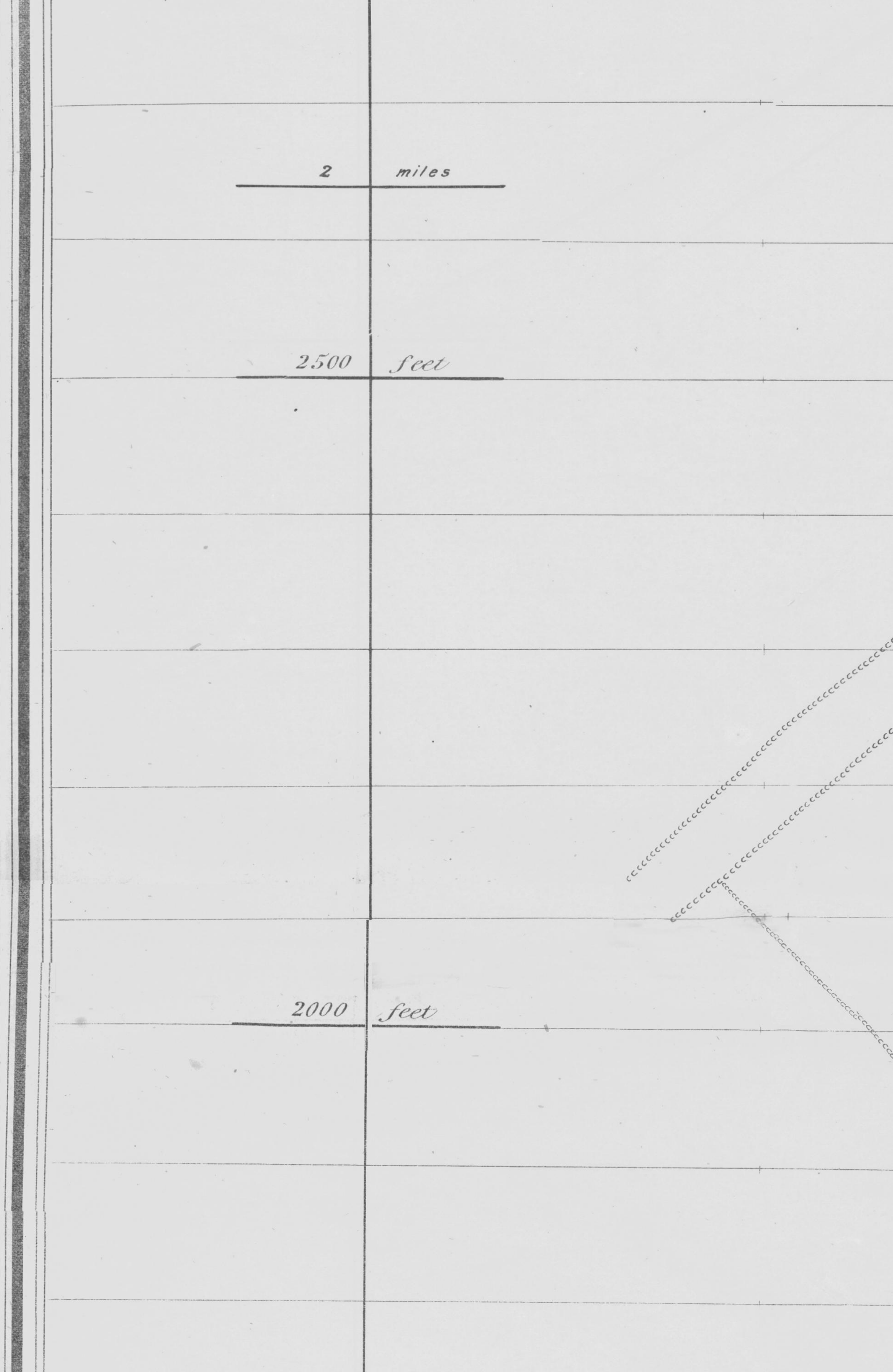

3500 feet
3000 feet

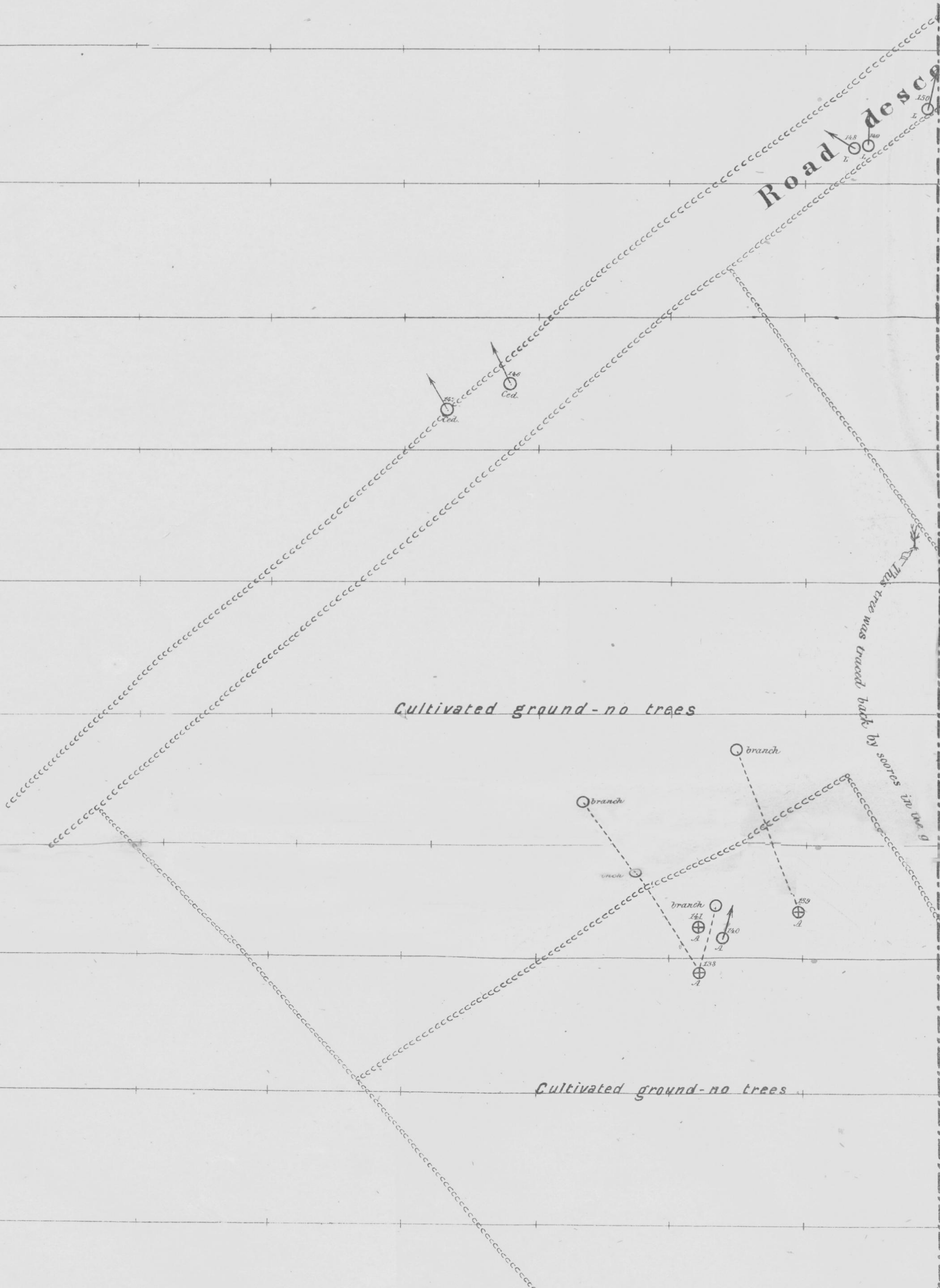

37
179
branch
178
A
177
A
174
A
180
A
172
A
175
A
This fell against other trees
173
A
36
176
A
Brown's orchard
The corn in this field lay S. 10° W.
Open groud

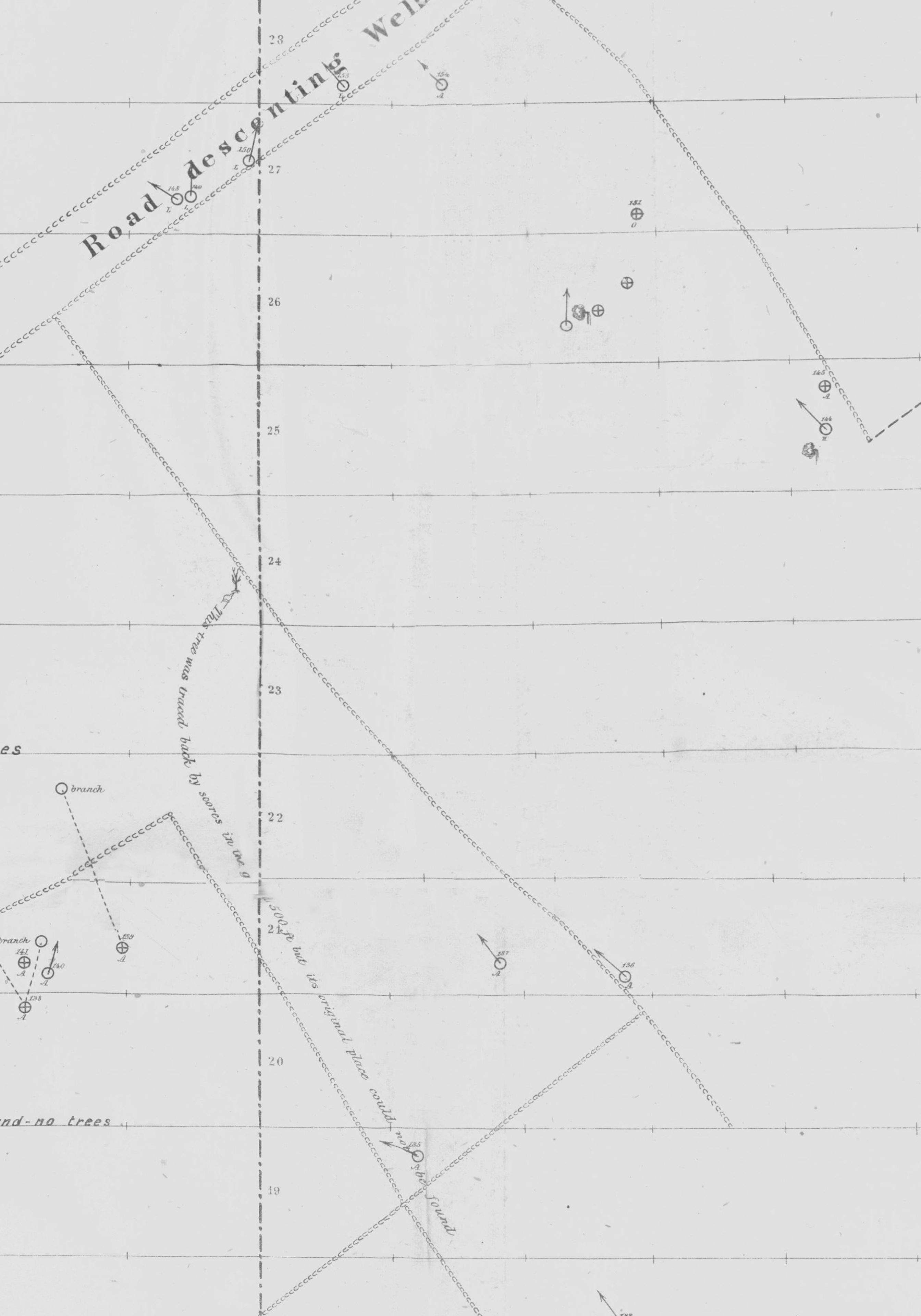

37
36
35
34
33
32
31
30
29
28
rees
173
A
172
A
181
A
182
A
183
A
184
A
185
A
170
A
169
A
171
A
186
A
187
A
188
A
189
A
130
A
191
M
166
C
Brown's Farm
167
Peach
CHAPIN
Open groud
156
A
BARN
Brown's Farn
Wellington
ill
ng
155
154

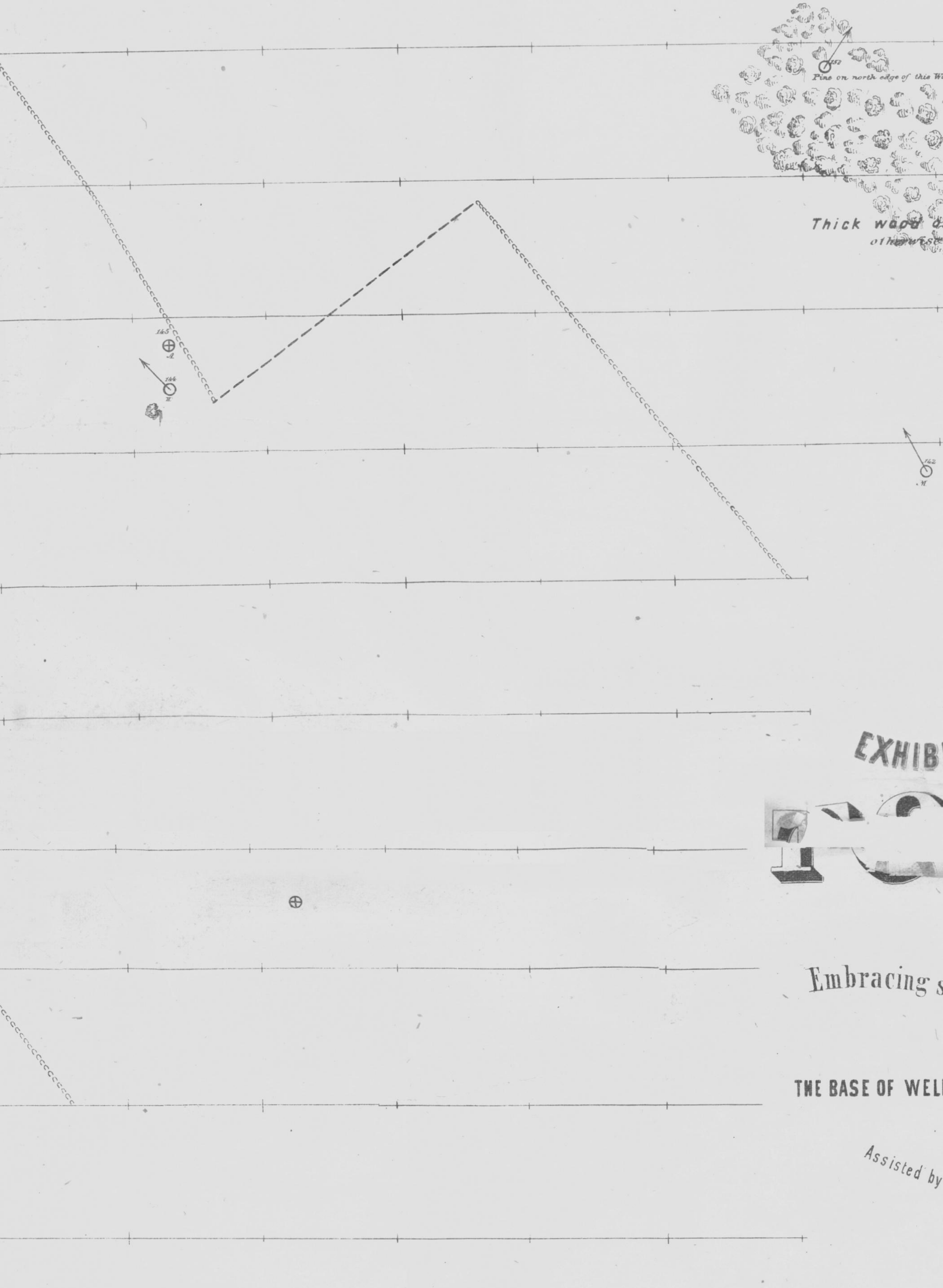

191
M
130
A
188
189
A
A
Turnip patch
167
S
Corn field
163
S
164
b
h
161
A
160
A
162
L
rown's Farm
159
Young orchard
158
A
157
peach
HAPIN
Corn field
156
A
BARN

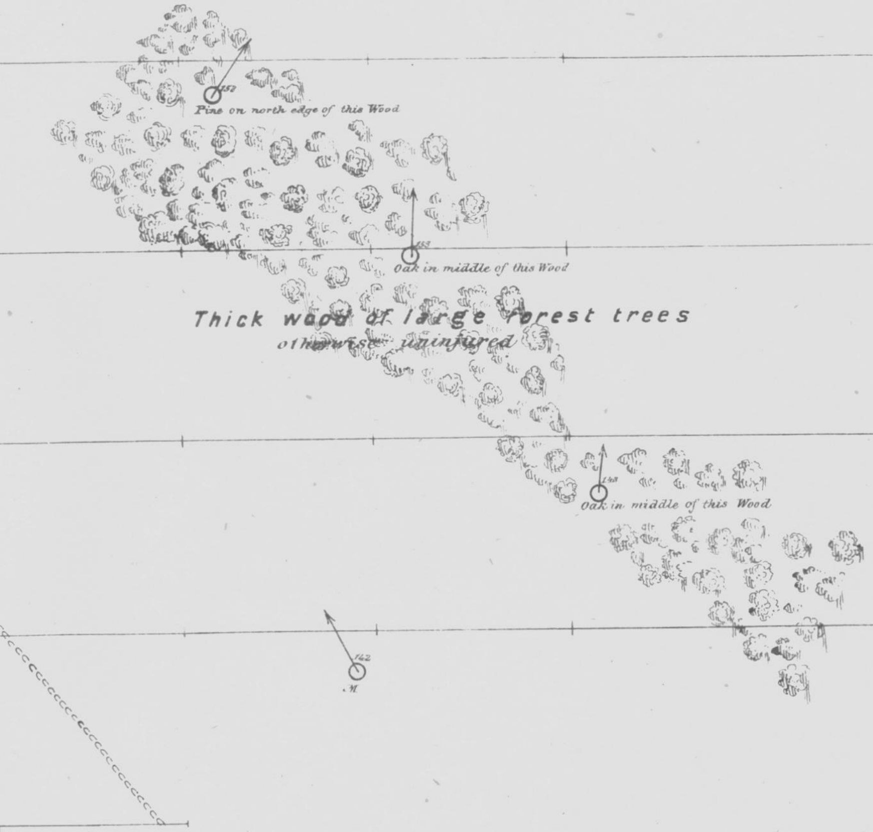
32
Poplars
158
N


2 miles
2500 feet
2000 feet


Road desc
150
L
148
L
149
L
147
Ced.
146
Ced.
This tree was traced back by scores in the g
Cultivated ground-no trees
branch
branch
nch
branch
141
A
140
A
139
A
138
A
Cultivated ground-no trees


Road descenting Wel
28
27
26
25
24
23
22
21
20
19
153
154
150
148
149
151
145
144
137
136
135
139
140
141
138
branch
branch
es
nd-no trees
This tree was traced back by scores in the g
500 ft but its original place could not be found


157
Pine on north edge of this W
Thick wood
otherwise
145
A
144
H
142
M
EXHIB
Embracing s
THE BASE OF WEL
Assisted by


Pine on north edge of this Wood
Oak in middle of this Wood
Thick wood of large forest trees
otherwise uninjured
Oak in middle of this Wood
142
M

# PLAN

## EXHIBITING THE RAVAGES OF THE

# TORNADO

## OF AUGUST 22$^{D}$ 1851

Embracing so much of its course as is included

between

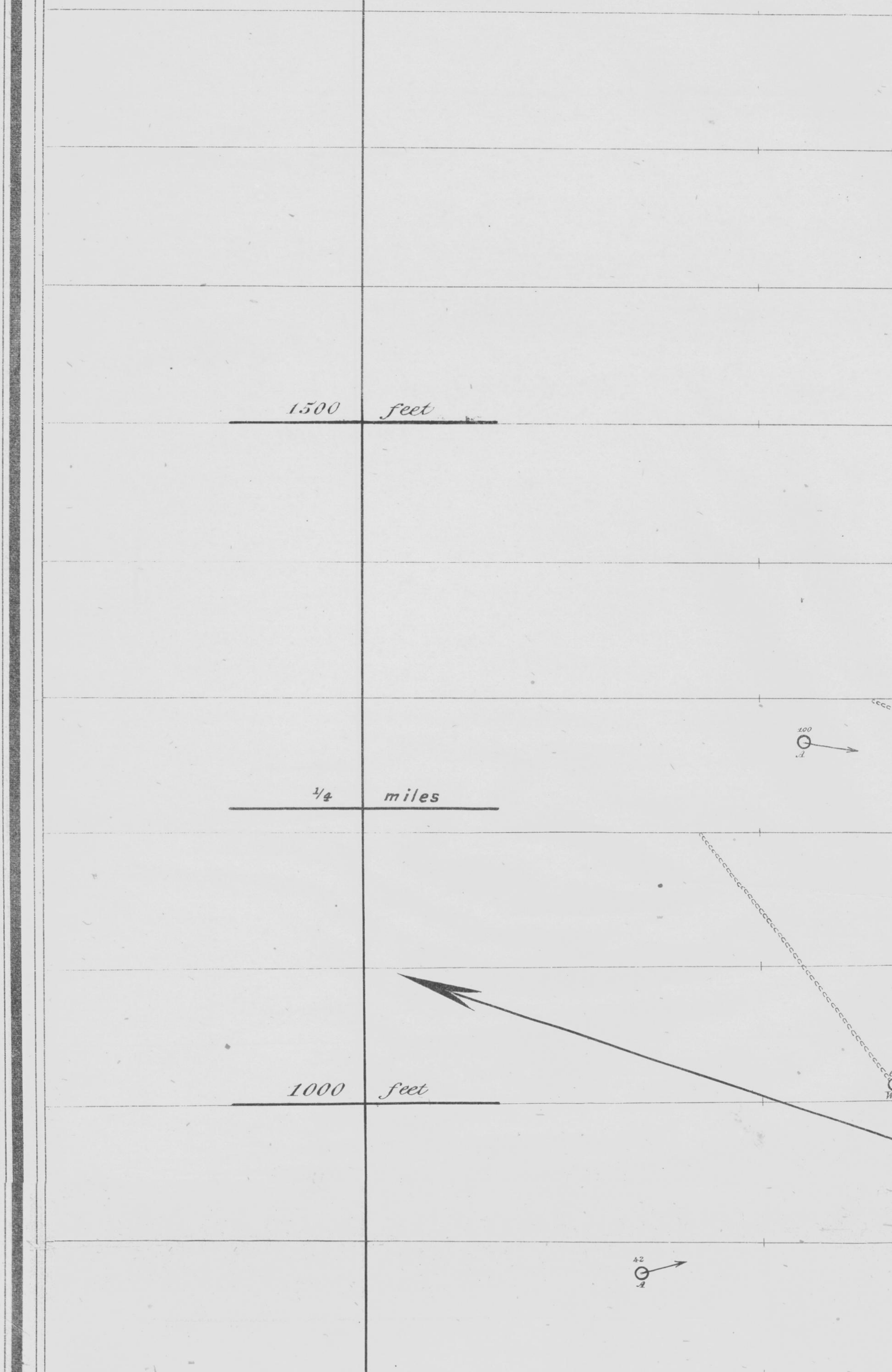
THE BASE OF WELLINGTON HILL IN WALTHAM AND MYSTIC RIVER.

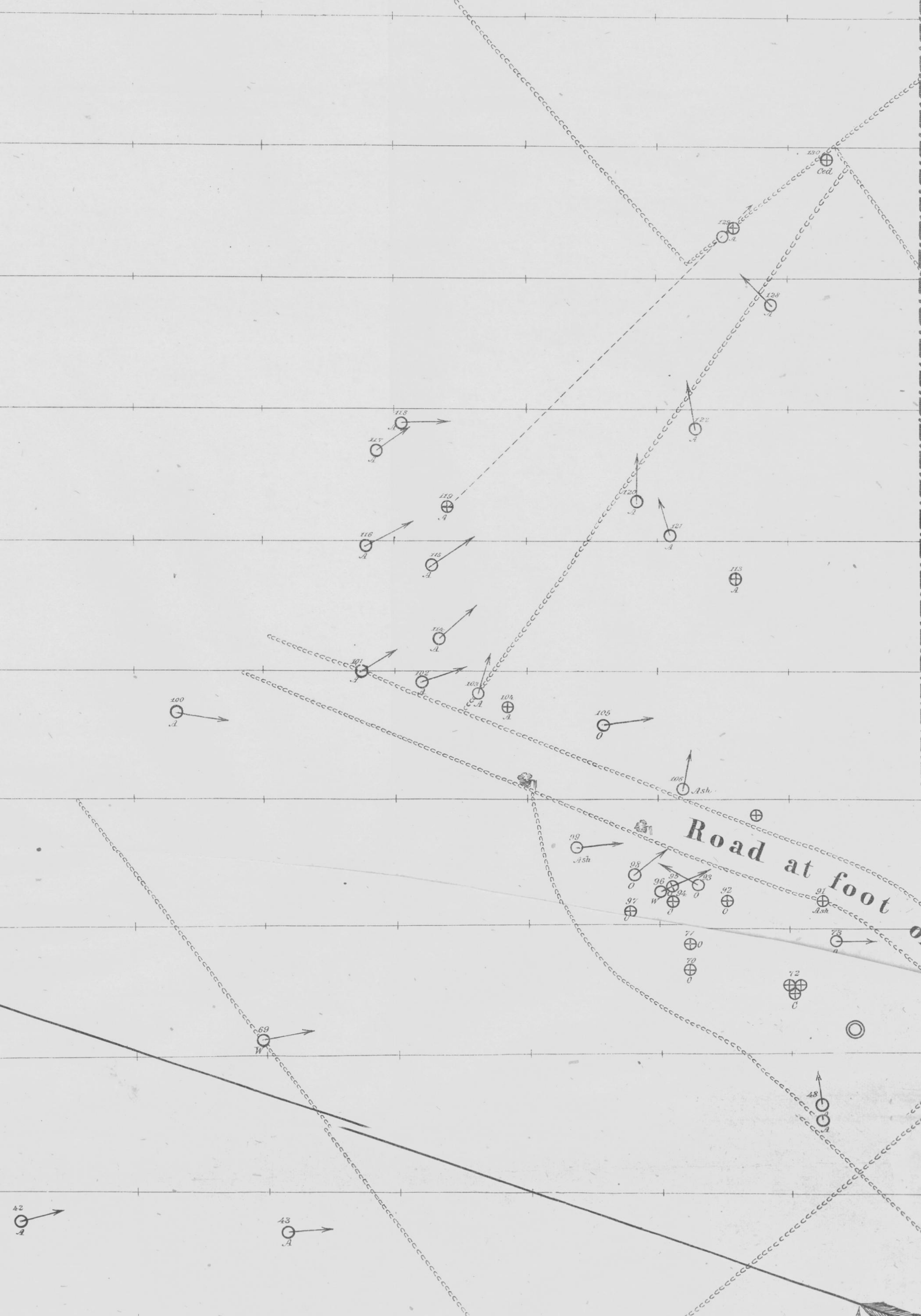
BY H. L. EUSTIS.

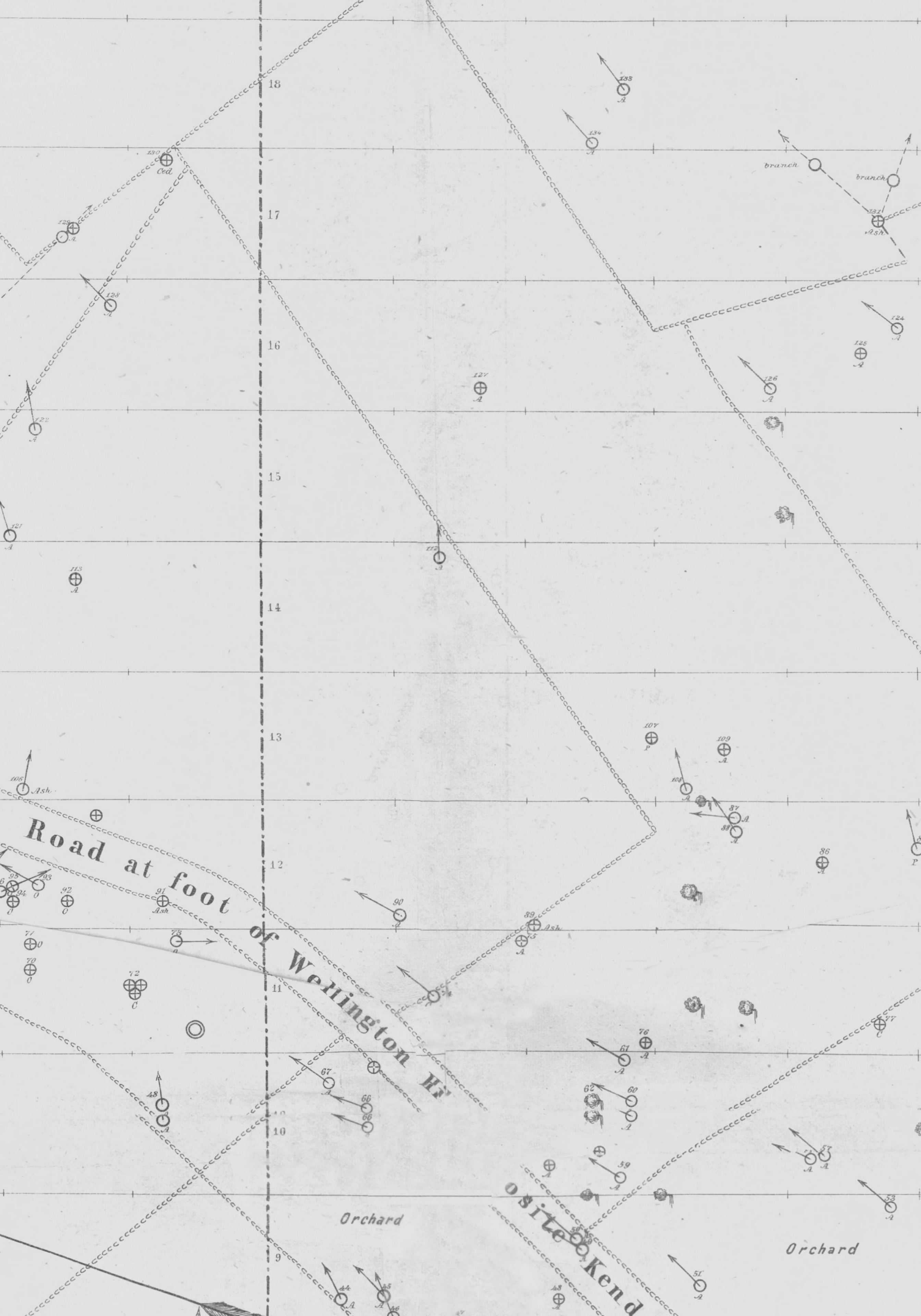
Assisted by the pupils of the Eng$^{r}$ Dept. of the Lawrence Sci. School.

Tappan & Bradford's Lith. Boston.

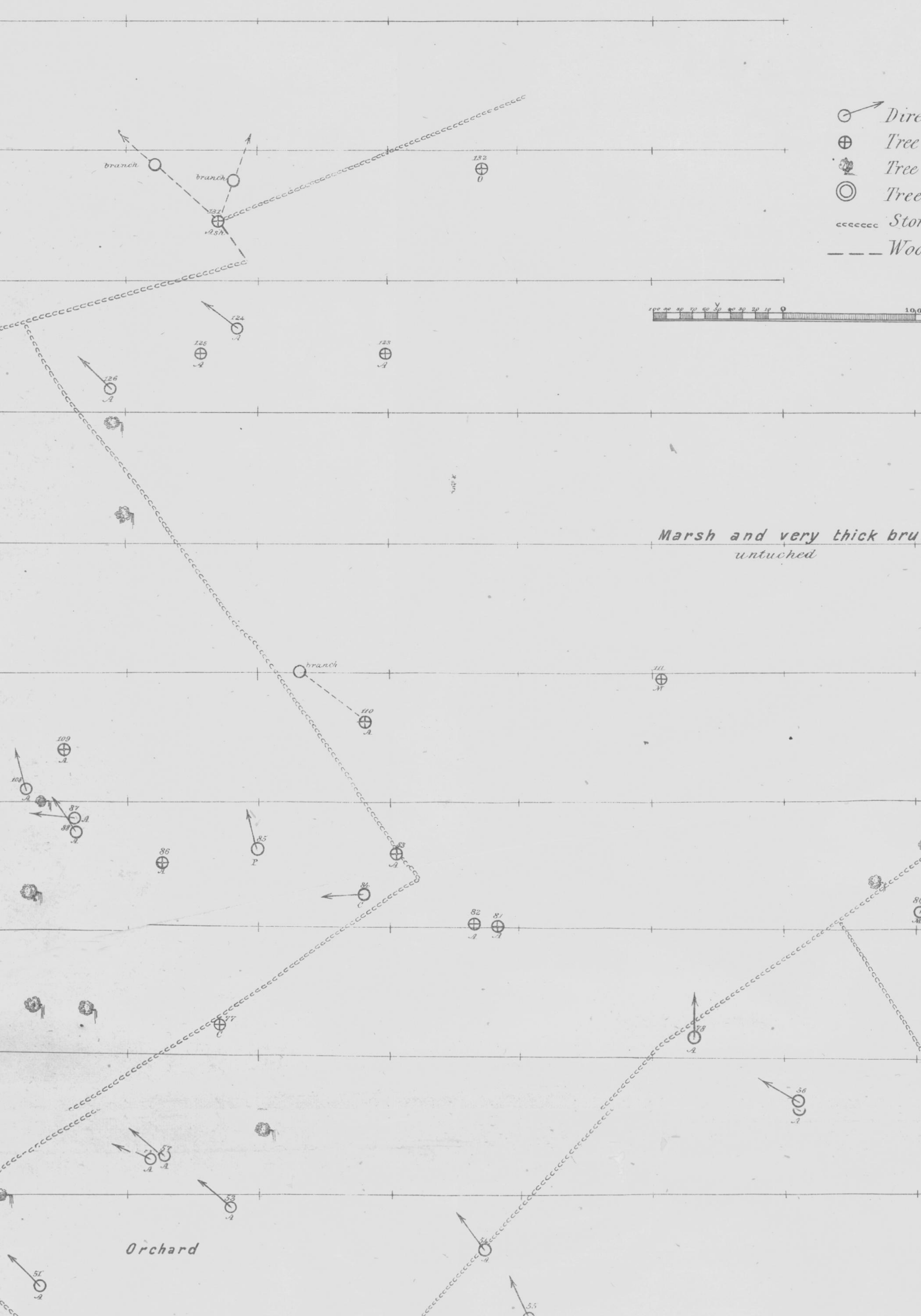
LEGEND


1500 feet
1/4 miles
100
A
1000 feet
42
A

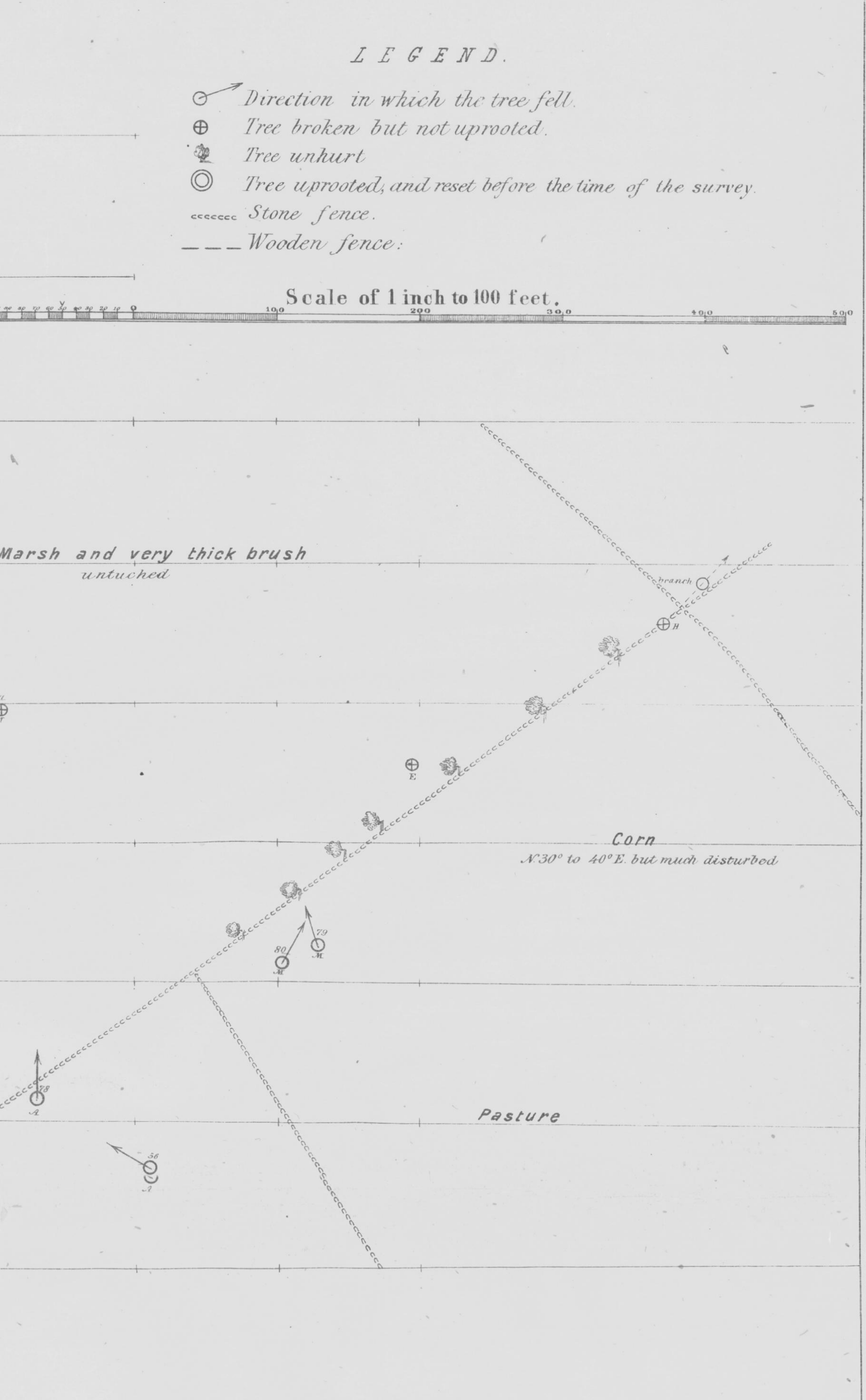

130
Ced
129
A
128
A
122
A
118
A
117
A
119
A
120
A
121
A
116
A
115
A
113
A
114
A
101
A
102
A
103
A
104
A
100
A
105
O
106
Ash
Road at foot o
99
Ash
98
O
96
W
95
93
O
94
O
97
O
92
O
91
Ash
71
O
73
O
70
O
72
C
69
W
48
A
42
A
43
A

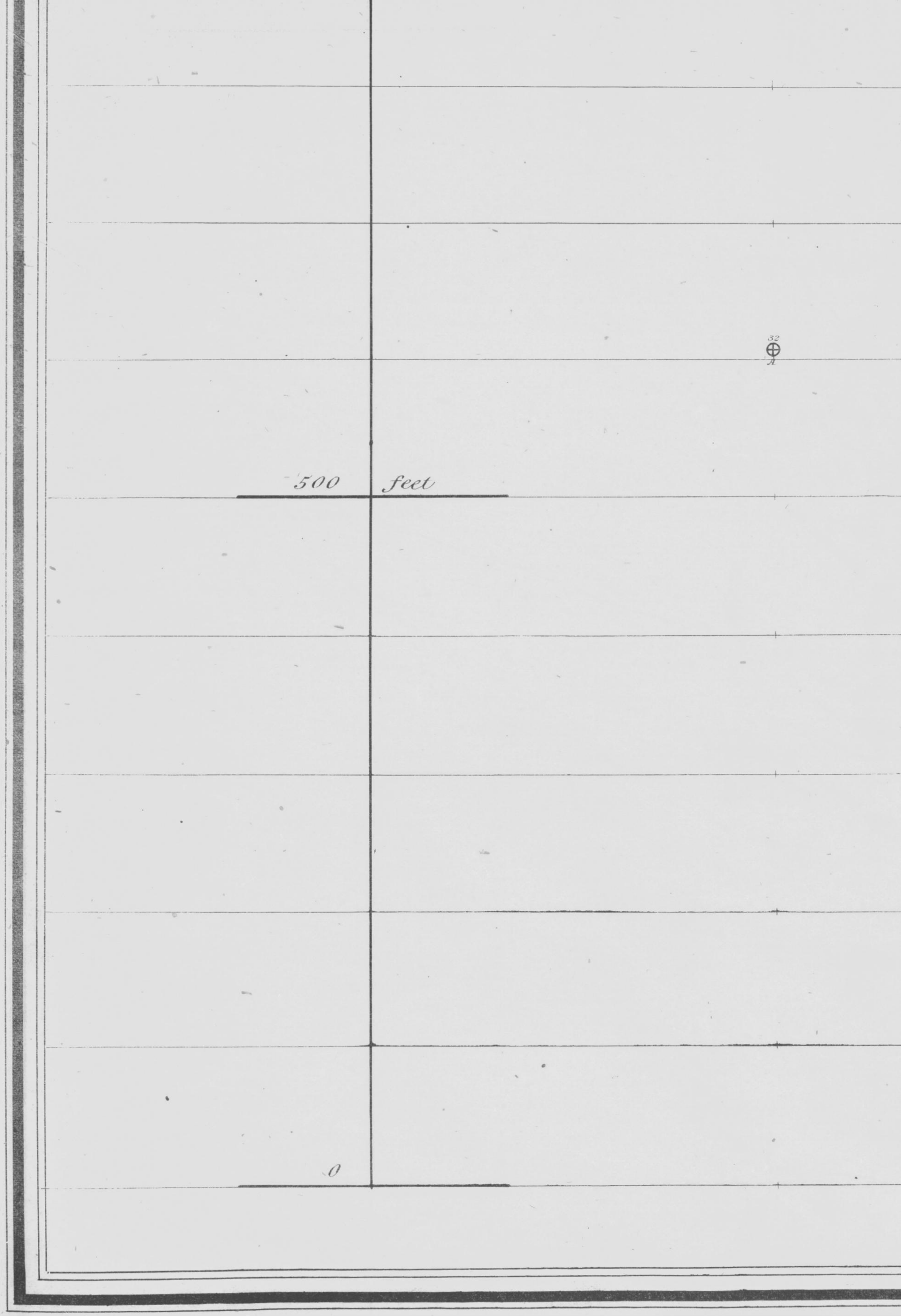


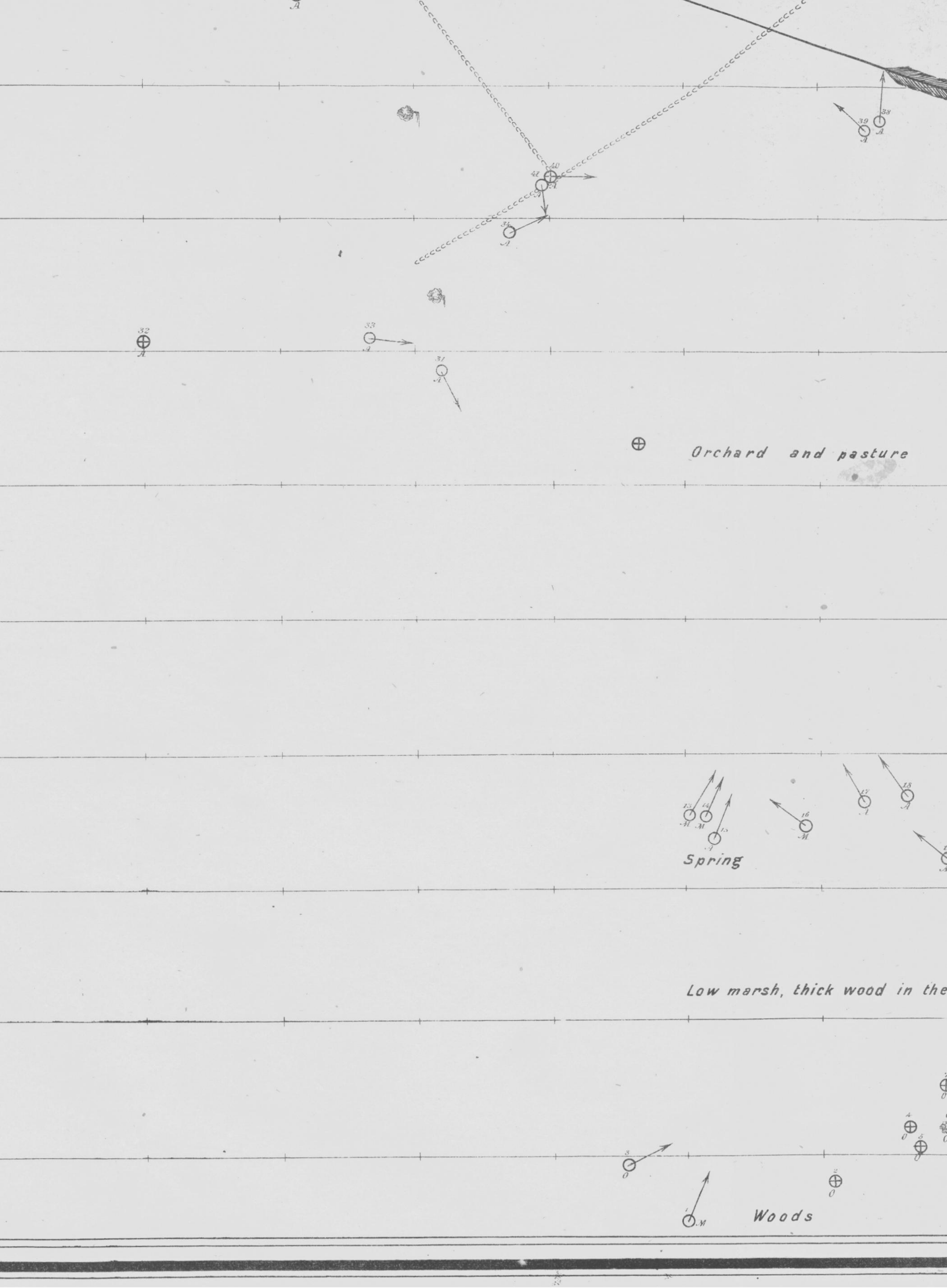
Road at foot of Wellington Hi
osite Kend
Orchard
Orchard
18
17
16
15
14
13
12
11
10
9
branch
branch
131
Ash
133
A
134
A
130
Ced
129
A
128
A
124
A
125
A
126
A
127
A
122
A
121
A
112
A
113
A
107
P
109
A
108
A
87
A
88
A
86
A
106
Ash
95
93
94
0
92
0
91
Ash
90
A
89
Ash
75
A
73
0
71
0
70
0
72
C
77
C
76
A
61
A
67
A
66
66
62
60
A
59
A
57
A
A
53
A
48
A
55
51
A
44
A
45
A
48
A

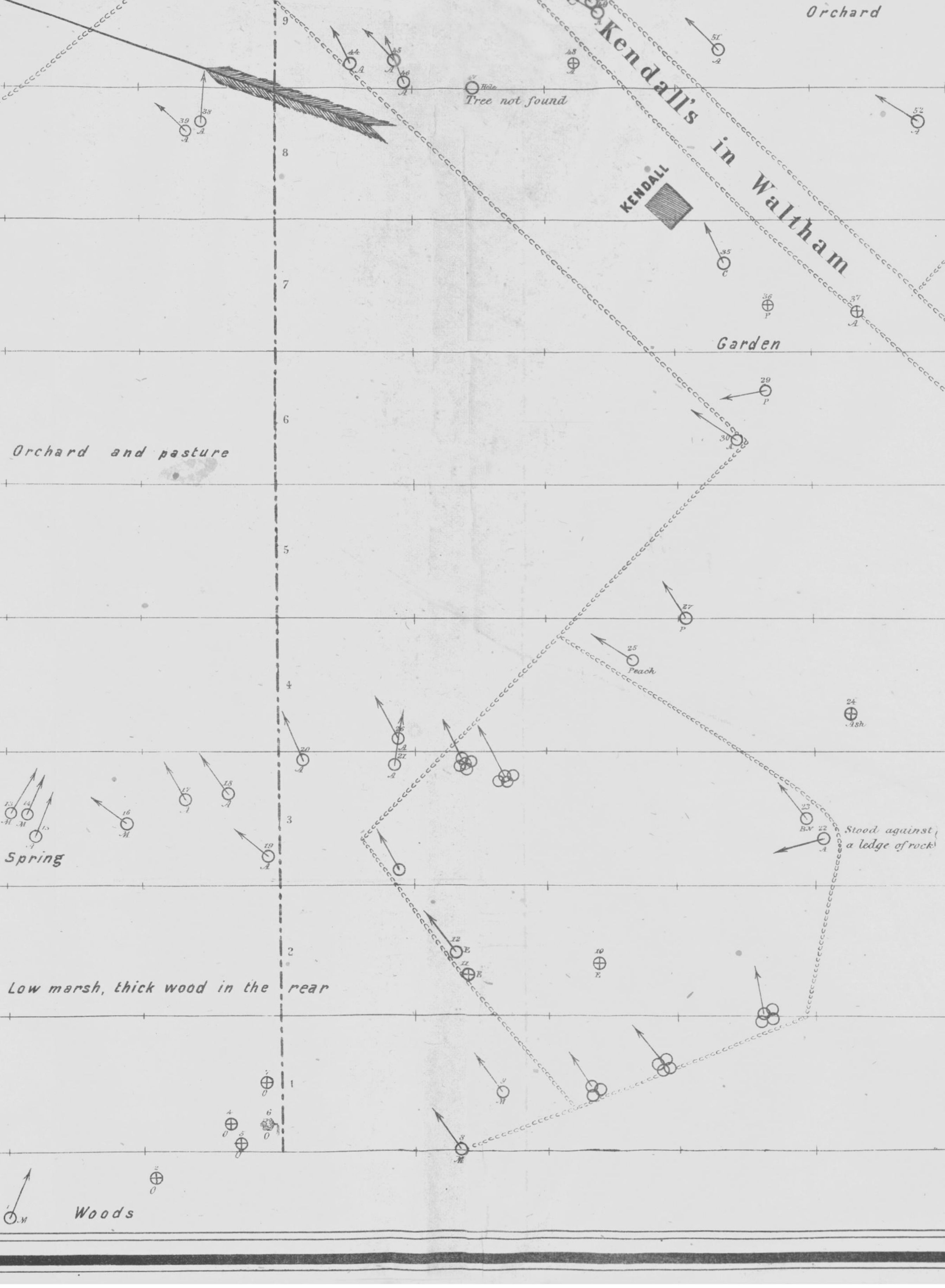

Dire
Tree
Tree
Tree
Ston
Woo
100 90 80 70 60 50 40 30 20 10 0
10
branch
branch
131
Ash
132
O
124
A
125
A
123
A
126
A
Marsh and very thick bru
untuched
branch
111
M
110
A
109
A
108
A
87
A
88
A
85
P
86
A
83
A
84
C
82
A
81
A
80
77
C
78
A
56
A
57
A
53
A
Orchard
54
A
51
A
55

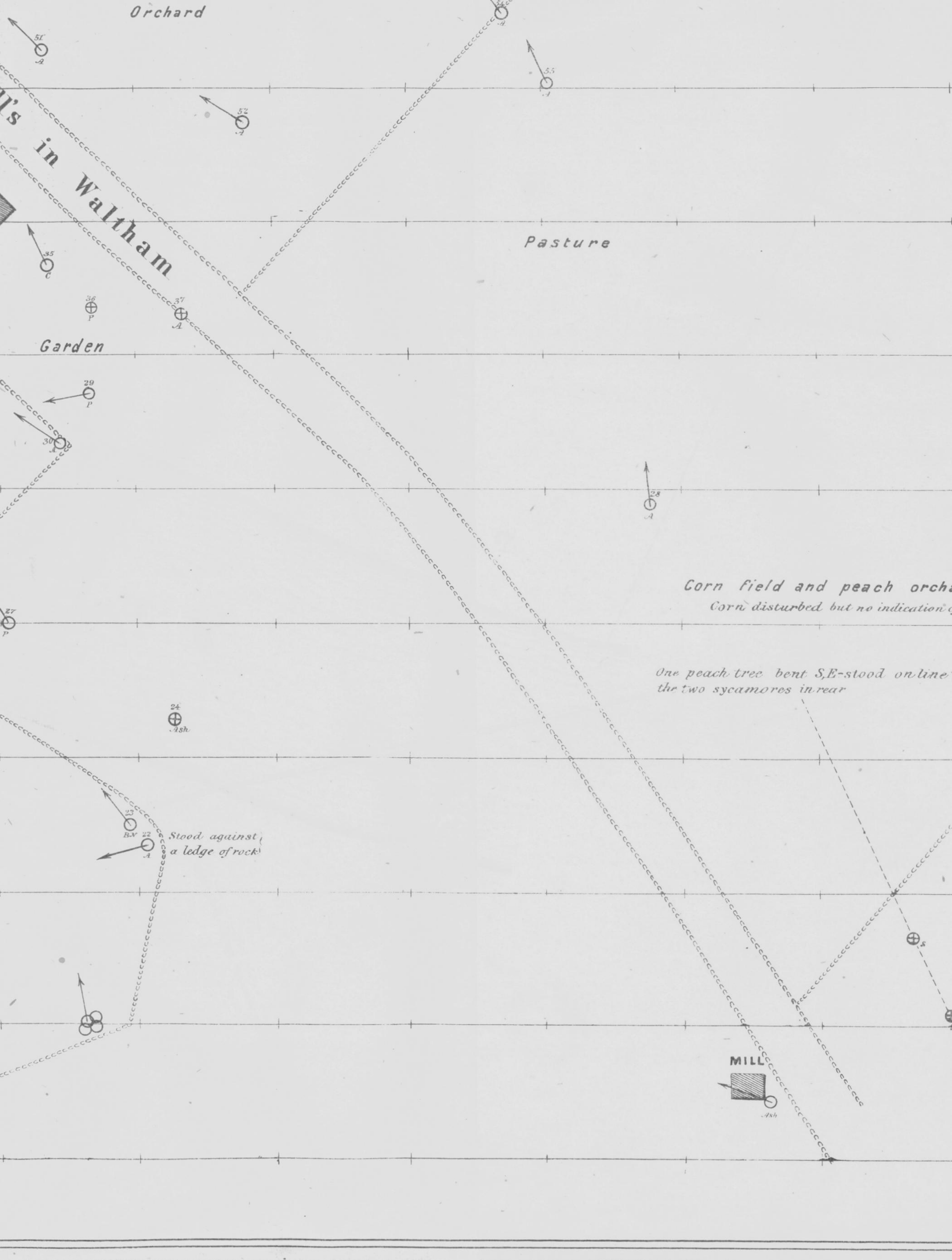
Tappan & Bradford's Lith. Boston.

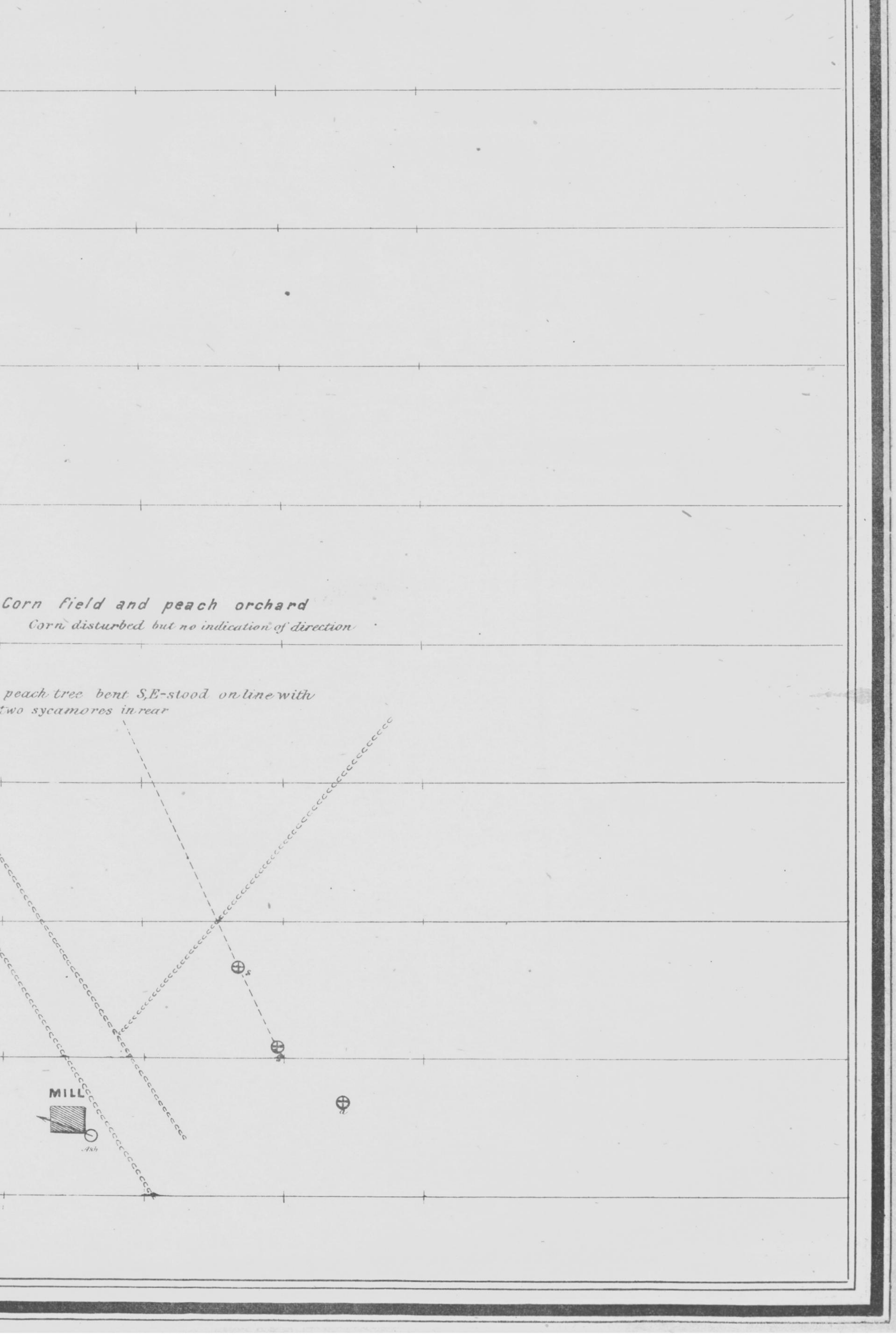

LEGEND.
Direction in which the tree fell.
⊕ Tree broken but not uprooted.
Tree unhurt
◎ Tree uprooted, and reset before the time of the survey.
Stone fence.
Wooden fence:
Scale of 1 inch to 100 feet.
0
100
200
300
400
500
Marsh and very thick brush
untuched
branch
H
E
Corn
N.30° to 40°E. but much disturbed
80
M
79
M
78
A
56
A
Pasture


32
A
500
feet
0


38
39
40
41
34
32
33
31
Orchard and pasture
13
14
15
16
17
18
Spring
Low marsh, thick wood in the
4
5
3
2
1
Woods


Orchard
Kendall's in Waltham
KENDALL
Tree not found
Hole
Garden
Orchard and pasture
Spring
Low marsh, thick wood in the rear
Woods
Stood against a ledge of rock
Peach
Ash
9
8
7
6
5
4
3
2
1


Orchard
51
A
52
A
55
A
ll's in Waltham
35
C
36
P
37
A
Pasture
Garden
29
P
30
A
28
A
Corn field and peach orcha
Corn disturbed but no indication
27
P
One peach tree bent S,E-stood on line
the two sycamores in rear
24
Ash
23
B.N
22
A
Stood against
a ledge of rock
s
MILL
Ash


Corn field and peach orchard
Corn disturbed but no indication of direction
peach tree bent S,E-stood on line with
two sycamores in rear
s
s
a
MILL
Ash